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W. A. HARDENBERGH and A. PRESCOTT FOLWELL
Editors

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The Editor's Page

Super Highways for the Nation

A program to cover the nation with more than 37,000 miles of four-lane highways has been announced by the Public Roads Administration. The cost will be shared by the Federal Government and the various states, and it will take 15 to 20 years to complete the system. No estimate of the cost has yet been made, but whatever it is, such a system will be a good buy. This country cannot afford not to have adequate roads.

Defects of our present system were recently emphasized by Charles Upham of the American Road Builders' Association who said, in referring to the existing road system of one of our eastern states: "This is not a horrible example—just a typical one. The system is made up of 4,500 miles of roads. A motorist driving over this system would negotiate 6,000 sharp curves. He'd climb 1,500 steep grades. He'd find 16,000 restricted sight distances. He'd go over 145 dangerous grade crossings. And in the 4,500 miles of driving, he'd cross 400 inadequate bridges."

It's about time we cut loose from the pre-World War I concepts of what a road ought to be and got busy on building some designed for the needs of today and tomorrow.

DDT Spraying for Disease Prevention and Fly Control

During 1945 and 1946, a number of cities used DDT for spraying all or part of their built-up areas. The objectives were generally poliomyelitis or other disease control, and fly reduction. Results of this work are now pretty well available, and are about what might have been expected—rather inconclusive. This was due primarily to the unplanned and on-the-spur-of-the-moment type of work; and to its lack of skilled direction. Costs were high for the same reason. In disease control work, DDT was not applied until after the peak of the epidemic had been reached, which was too late to accomplish much; or where disease rates were not at an epidemic level. That the rates *might* have reached epidemic level without spraying is possible, but cannot be determined. In fly control, it has been demonstrated that a single application of DDT will have no lasting effect, but Army experience indicates that two, three or more applications can accomplish remarkable results. Mosquitoes are more susceptible to a single application, especially in the late summer.

It is hoped that many municipalities will begin to plan now for DDT application for the 1948 season. Fly and mosquito control have many advantages in comfort, and more in disease control. In planning to use DDT, with expenditures within the easy reach of the normal municipality, there are three major essentials: (1) Start application early, before the fly, mosquito or disease problems become major; (2) plan on a minimum of several applications, directing these at producing areas only; and (3) place the work under the direction of a competent entomologist, with an engineer to handle organization and personnel.

It seems to have been definitely proved that flies are a factor in the spread of poliomyelitis; and it is well-known that they spread other diseases. Mosquitoes are responsible for the spread in this country of malaria and dengue. And both are pests and nuisances.

There is No Substitute for Effective Chlorination

In a recent outbreak of water-borne typhoid, this time in California, the water was not being chlorinated, though provision for chlorination had been made some years ago. The supply was a small one—less than 200 consumers—and therefore not subject to important state regulations. However, the condition of the supply was known and had been a subject of correspondence for 17 years. Subsequent to the resulting grand jury investigation of the epidemic, the County Health Department budget was increased more than 50%. It really takes a good epidemic to get done some of the things that, by all the rules of common sense, ought to have been done long before. To our mind, there isn't any substitute for effective chlorination of all water supplies all of the time—a statement that may stir the memories of war-time experiences.

Hydrant Location in the Automobile Age

Forty years ago a fire hydrant was placed far enough back from the curb to clear the hubs of horse-drawn trucks. In the period since then, no other criteria for placement appear to have been developed, despite the fact that traffic conditions have changed very materially. In some cities, the cost and inconvenience due to fire hydrants damaged by motor traffic are appreciable. Trucks may have a rear-end hangover that will reach far beyond the curb; some of our more modern automobiles are capable of reaching with front or rear bumper a considerable distance beyond the curb. Perhaps it is time to analyze these and other similar problems in the light of changed conditions and come up with some new bases of engineering design. The use of hydrants that will fail in a predetermined way or are easily repairable is advantageous meanwhile, but consideration ought to be given to a better and safer location, perhaps near to the building line.

That Medical Service Corps

The bill establishing the Medical Service Corps has been passed by Congress. In an effort to obscure still further its unsound and discriminatory provisions, it was amended in the Senate to provide for a Sanitary Engineering Section. This amendment does not in any way mitigate the fact that non-medical personnel are still considered as mere technicians, unworthy of the same rate of promotion and the same rank as doctors of medicine, doctors of dentistry and doctors of veterinary medicine. It does not change the hard fact that those engineers and other professional men of the old Sanitary Corps will play second—or third—fiddle to the pharmacists who are now in control. The amendment merely makes the administrative set-up more unworkable than it was before.

When you need special information—consult the classified READERS' SERVICE DEPT., *pages 69-73*

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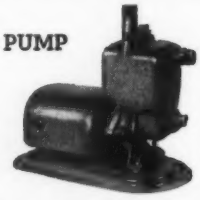

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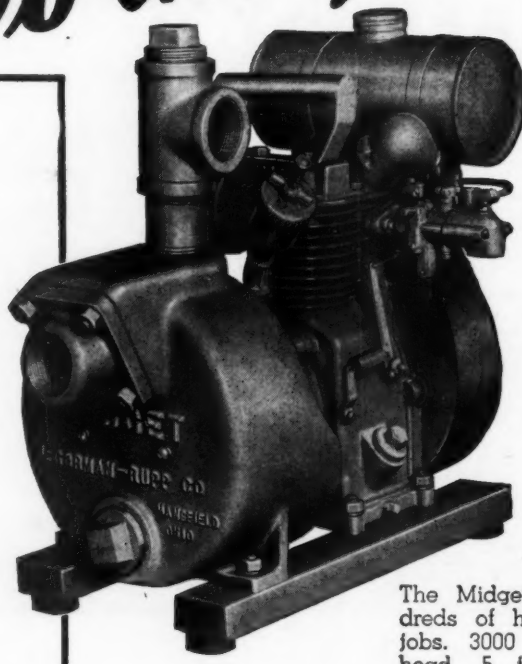

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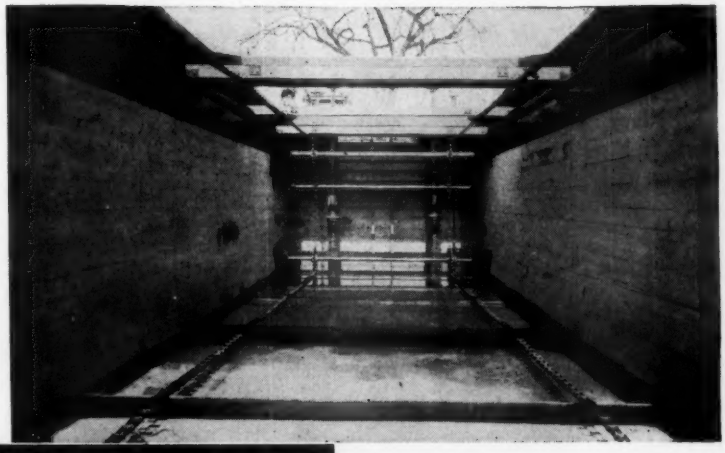

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Sewer Rental Data

Methods employed by cities in charging sewer rentals, and relative rates charged for outside-the-city connections.

INFORMATION has been received from 578 cities in regard to sewer rentals; this is presented herewith. These data represent the first installment of information obtained through the cooperation of city engineers. It is anticipated that about as many more replies will be received as are now in hand; and information from them will be compiled and published later. Of the 578 cities replying, 148 report that sewer rentals are charged. These same 578 cities also reported on waste disposal improvements planned, as indicated elsewhere on this page.

Information on Rental Charges

Alabama—Five replies. One city, Hartselle, charges a flat rate of $1, which covers the cost of the sewerage program. There is no extra charge for connections outside the city limits. Ozark charges $75 per connection outside the city.

Arizona—Three replies. Glendale has a sewer tap charge of $26, but no rental; Tucson has no rental inside the city, but charge outsiders $2.50 per fixture.

California—Thirty-two replies. Two cities—Healdsburg and Oxnard—charge sewer rental on a flat rate basis and one—Burlingame—on water use. El Centro charges outsiders $20 for businesses and $5 for residences per month. Orange and Oroville do not allow outside connections. Those living outside of the city limits are charged as follows by other cities: Pacific Grove, $15 per dwelling; Pasadena, $1 per month for single family dwelling; Healdsburg, double the inside rate; Merced, $10 per year per home; Oxnard, 50c per connection; San Leandro, $18 per year; San Luis Obispo, $10. In Burlingame the charge for sewer rental is 2c per thousand gallons of water used.

Colorado—Twelve replies. Six cities report sewer rentals, one—Ft. Collins—on the basis of water use, two — Boulder and Longmont — on the number of plumbing fixtures, one—Grand Junction—on a percentage of the water bill and two—Golden and Sterling on flat rate. The Sterling rate is 50¢ a month for domestic and $1 a month for commercial users. Boulder and Longmont charge those outside the city double the inside rate; and Ft. Collins charges them 25% more.

Connecticut — Ten replies. One — Darien—city charges sewer rental, this being based on the number of plumbing fixtures.

Florida—Nine replies. One city—Ft. Lauderdale—charges sewer rental on the basis of water use; one—Key West—on the number of plumbing fixtures; and one—Lakeland—by a fixed per cent of the water bill. Ft. Lauderdale charges 25% extra for service outside the city.

How This Information Was Obtained

Questionnaires were sent to all City Engineers. The data tabulated here are from the first 578 replies received. It is expected that about as many more will be received in the near future, representing about one-third of all cities having engineers. The 578 cities reporting so far also stated that they contemplated the following improvements, mostly during the next 12 months:

220 sewage treatment plans or enlargements
89 additional sludge treatment installations
94 waste disposal incinerators.

The Editors

Georgia—Nine replies. Two cities report sewer rentals, one—Tifton—charging on the number of plumbing fixtures and the other—Athens—on a flat rate basis. Athens charges $5 per year for those outside the city. Though it does not do so now, the rental program in Athens is expected eventually to finance the sewerage program. Macon has no rentals but charges outside homes $10 per year for service.

Idaho—Four replies. One city—Preston—charges on the basis of a flat rate. The outside rate at Preston is 1½ times the city rate. Twin Falls charges $100 plus the tap fee for outside connections.

Illinois—Twenty-seven replies. Nine cities report sewer rentals, five—Barrington, Oak Park, West Chicago, Jacksonville and Mattoon—on the basis of water use, one—Naperville—on a percentage of the water bill and three—Canton, Elmhurst and Glen Ellyn—on a flat rate. Naperville charges 10% of the water bill or 50c a month minimum for residents and furnishes no service outside the corporation. Barrington uses various methods of charging inside the city, and charges double outside; Canton charges $25 for taps outside the city; West Chicago charges $2.50 per quarter outside.

Indiana—Eleven replies. Four cities charge rentals, three—La Porte, Peru and Tipton—on the basis of water use and one—Marion—on a percentage of the water bill.

Iowa—Thirteen replies. Three cities—Fort Dodge, Sibley and Waterloo—charge sewer rental on the basis of water use and three—Sioux City, Storm Lake and Des Moines—on a percentage of the water bill. Des Moines charges outsiders 30% more, while Waterloo charges them double. Indianola expects to charge rentals soon.

Kansas—Twenty replies. No city reports levying a sewer rental.

Kentucky—Six replies. No city reports charging sewer rentals for residents. Danville charge 25c per month for connections outside the city, and Lexington charges outsiders as follows: $4.20 minimum; 4-rooms, $5.40; 5-rooms, $6; 7-rooms, $7.20; 8-rooms and over $7.80. These are annual charges. Lexington has a large built-up residential area just beyond the city limits. Sanitary sewers in these areas have been built by the subdivision owners, but the sewage generally passes through the city sewers for the entire length of the sewers. The city does not maintain nor service sewers beyond the city limits, but it collects annual rentals, which are used to enlarge and improve the treatment plant and to provide sewerage facilities made necessary by reason of the sewerage entering from beyond the city limits. An increase in rates is under consideration.

Louisiana—Two replies, and *Maine*, nine replies. No city reported charging sewer rentals.

Maryland—Three replies. Two cities — Salisbury and Westminster—charge rentals, both on the basis of the number of plumbing fixtures. Salisbury charges for service outside the city, a $100 tapping fee, plus $15 yearly rental; Westminster charges for outside service in proportion to tax.

Massachusetts — Twenty-six replies. Five cities charge rentals, 3—Marlborough, Reading and Brockton—on the basis of water use, one—Peabody—on a percentage of the water bill and one—Concord—on a flat rate. Outside of the city charges by Lawrence are 18½¢ per person yer year, and by Orange $1 per year per connection. The matter is pending in So. Hadley.

Michigan—Thirty replies. Of ten cities that report sewer rentals, 7—Lincoln Park, Mason, Monroe, Pontiac, Traverse City and Wayne are on a water use basis, Zeeland is on a flat rate, and 2—Grayling and Ludington—on a percentage of the water bill. Petoskey plans to start charging rentals soon. Cities which have a special provision for outside service include Dearborn, tapping fee $50 and annual charge $5 per family; Pontiac double the inside the city rate; and Zeeland, $12 per year. Traverse City has no outside connections. Petoskey plans to initiate a rental charge.

Minnesota—Seventeen replies. Three cities—Columbia Heights, Minneapolis and Montevideo charge sewer rentals, all on the basis of water use. Outside the city charges are: Cloquet, $1 per residence and $4 per business (no charge inside city limits); Ely, $50 for tapping, and 75¢ per month.

Mississippi—Five replies. Two cities—Pascagoula and Yazoo City—charge rentals on the basis of the number of plumbing fixtures. Corinth charges for service outside the city at the rate of $5 per year; and Pascagoula charges $10 per year for one bathroom and kitchen, with an extra $1 per year for each additional fixture.

Missouri—Nine replies. One city—Mexico—charges a rental, which is based on a flat rate. Springfield charges residences outside the city limits $6 per year; and industrial plants $60 per year minimum.

Montana—Three replies. One city charges sewer rental on a flat rate basis.

Nebraska—Seven replies. Two cities—Norfolk and Schuyler—charge a flat sewer rental rate. For those outside the sewer district, Norfolk charges 25¢ per month.

New Hampshire—Two replies. Laconia plans to establish a sewer rental charge on the basis of water use. No city reports sewer charges are now being collected.

New Jersey—Twenty-seven replies. One city—Clifton—charges on the basis of water use, one—Haddonfield—on the number of plumbing fixtures and one—Matawan—on a percentage of the water bill. Leonia does not state the method of charge. Clifton charges on the basis of meters; Matawan charges 20% of the water bill inside the city and 40% outside. For outside the city service, Glen Rock charges $25 to $50 per year per dwelling, and Jamesburg $25 for a small house.

New Mexico—Four replies. One city—Roswell—charges sewer rentals on a water use basis, one—Deming—on the number of plumbing fixtures and one—Carlsbad—on a flat rate.

New York—Thirty-six replies. Two cities—Bath and Fairport—charge on the basis of water use, one—Saranac Lake—in part on a flat rate, and one—Garden City—on the number of plumbing fixtures. Garden City charges only tax exempt and outside-the-city property. Ithaca bases outside charges on the number of fixtures; Fairport charges $10 per year flat rate outside; Larchmont charges outsiders $190 to connect and $10 per year. The $190 was figured on each family's share in the sewer system, residents having paid it in taxes, while the $10 is the proportional cost of operating the treatment plant. Middletown charges $125 for an outside connection, while Ravena charges outsiders $15 per year.

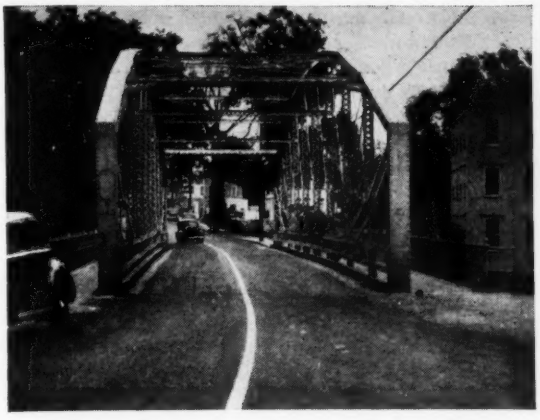
North Carolina—Six replies. Wilmington charges on the basis of plumbing fixtures and Lexington levies a flat rate. The outside charge at Wilmington is double.

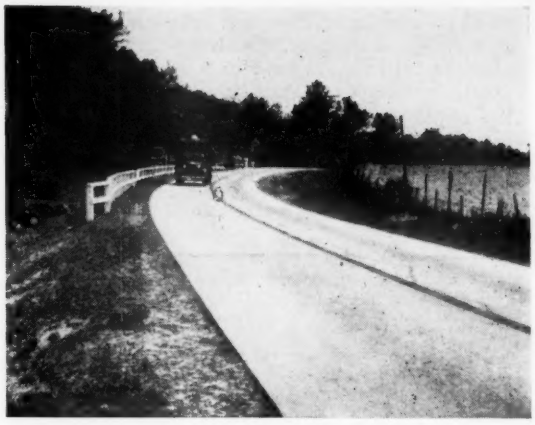
North Dakota—Two replies. Jamestown uses a flat rate and Dickinson charges on the basis of the water bill percentage. The charges at Jamestown are the same for outside the city as for inside, but those not using city water are charged a flat $3.45 per month.

Ohio — Forty-two replies. Twenty-three cities in Ohio report charging sewer rentals. Of these, 14—Ashtabula, Barberton, E. Cleveland, Columbus, Cuyahoga Falls, Dayton, Delaware, Lancaster, Mansfield, Newark, Sidney, Van Wert, Xenia and Cleveland—are on the basis of water use, 3—Celina, Washington and Wilmington—according to the number of plumbing fixtures, 2—Cambridge and St. Mary's—on a flat rate and 4—Bryan, Wooster, Oberlin and Findlay—on a fixed percentage of the water bill. Comments and data include: Ashtabula, 4¢ per 100 cf. inside, 7¢ outside; Bellefontaine uses 25% of water bill income to pay for its sewage disposal plant; in Bryan, the charge is 50% of the water bill, $1.50 minimum, with no outside the city service; Cleveland, 18¢ per 100 cf. inside, 28¢ outside, which covers operation and maintenance; Columbus, the outside rate is 90% more than inside the city; Cuyahoga Falls, outside rate 50% of the water bills; Delaware, the charge is pro-rated as to persons served; Lancaster charges an additional 25% for outside service; Manfield, same outside as inside; Marion, $10 per vear outside; St. Marys and Sidney, 10% more outside; Washington, a rate survey is now being made by Paul Uhlman and Associates; Wilmington, rentals cover operation and repair costs; Wooster charges 10% more outside; the charges in Xenia are based on water use, except there is a flat rate for dwellings.

Oklahoma—Thirteen replies. Three cities charge rentals, Ardmore on a flat rate basis, Tulsa on the number of plumbing fixtures and Muskogee on water

(Continued on page 32)





On the average road: A narrow bridge every ten miles; a sharp curve nearly every mile—and three "blind" spots per mile.

How Modern Highway Design Reduces Accidents

Design speeds; highway capacity and highway types; passing requirements; accidents in relation to highway types; and other safety features of highways, as presented in a paper before the Michigan Safety Conference

By HARRY C. COONS

Deputy Commissioner-Chief Engineer, Michigan State Highway Department.

IN DESIGNING highways for efficient and safe operation, the basic factors to be considered are the characteristics of the traffic to be served and of the terrain to be traversed. The significant characteristics of traffic are its volumes, speed, and composition. The important topographical features are those which affect highway alignment and sight distance, including roadside developments which generate or influence traffic movement.

Decisions regarding design speed, sight distances, the number of traffic lanes and type of highway, as well as the width of lanes are all made with reference to these factors. To a very large degree, highway safety depends on how wisely these decisions are made and on how accurately the final design provides for facilities that meet the needs and conditions that will actually exist during the expected period of service.

Design Speed

Almost the first thing the highway designer needs to know is the proportion of traffic traveling in the higher speed ranges. On the basis of this information he decides upon the design speed, which, in turn, is basic in establishing all the other design factors that provide for the safe movement of traffic. Sight distance, lane widths, lateral clearance to roadside obstructions, maximum curvature, superelevation on curves, and the general cross section must be consistent with design speed.

Speed observations made on Michigan rural trunklines in 1941, revealed that 85 per cent of all vehicles traveled at speeds of 60 miles per hour or less. Other studies made following the lifting of speed and other restrictions in 1945, showed that this 60-or-below group had increased to include nearly 95 per cent of all traffic. It is probable that speeds are now tending to return to the 1941 distribution as the supply of new cars become more normal.

These Michigan data, as well as a wide record of experience elsewhere, indicate that there is not much justification for a design speed on rural primary trunklines of above 70 miles per hour. This standard is applicable for approximately level terrain. In rolling sections, a design speed of 60 miles per hour is desirable. For expressways in urban areas, 50 miles per hour can be considered adequate.

Contrary to some schools of thought, it appears to be unlikely that highways built for these speeds will be inadequate for higher speeds of the future. Top speeds are usually governed by the preference of the drivers rather than by the speed capacity of the vehicles; raising the latter will not raise general speed rates except as accompanying improvements in vehicular stability, acceleration, and braking, increase the confidence of large numbers of drivers in their driving competence and control.

Consistency in Design Important

A vital safety requirement in relation to design speed is consistency in its application. The accident rate on road sections with isolated sharp curves is more than double that on sections where five or more such curves occur to the mile. Safety demands that the same design speed be used on the same kind of highways throughout large areas. In locations where topographical or other conditions make a variation absolutely necessary, transition to lower speed sections should be smoothly graduated and clearly marked with signs.

In considering the subject of speed in design, it

is well to keep in mind that increases in the number of vehicles on a highway, even those within its practical traffic capacity, cause reductions in top speeds. Take, for example, a 2-lane highway with a design speed of 70 miles per hour and an average 24-hour traffic of 3000 vehicles. With the normal distribution of traffic in hourly volumes, only an insignificant proportion of the day's traffic will be able to average within two or three miles of 70 miles per hour; these cars will be traveling at the lowest volume hours. Of all the traffic that wishes to travel at 70 miles per hour, about half will be able to maintain an operating speed of from 60 to 67 miles per hour. Of the remainder, 20% will encounter hourly volumes of more than 350 vehicles and will be limited to average operating speeds of 53 miles per hour or less.

Thus, it will be seen that only a small percentage of average traffic desires to travel at the highest rates of speed, and that a large percentage of this is limited to considerably less than the desired rate. It also is apparent that design speed is closely related to the determination of practical highway capacity.

Highway Capacity and Highway Types

Highway capacity in relation to traffic volumes is a primary factor in safety. When a highway is loaded

No room to pass here.

to the point where movement is reduced to an unreasonably low speed, some drivers become impatient and either follow too closely the vehicle ahead or take chances at passing in the face of opposing traffic. The result is a sharp increase in the number of accidents.

Reduction of such conditions depends not only on the provision of an adequate number of lanes, but on the selection of lane arrangement best suited for safe traffic use. Highway and traffic engineers have given the problems of highway capacity and type much study. In the course of these studies, the importance of the overtaking and passing maneuver has been recognized as basic. As traffic increases from minimum volume, the number of passing required to permit all drivers to drive at their desired speed will increase somewhat proportionately. In actual practice, the number of passings will increase proportionately only until a certain volume has been reached; as this volume is exceeded, the number of passings first will increase at a decreasing rate, and then will begin to decrease.

Safe passing on 2- and 3-lane highways requires that the driver shall have a long clear view of the road ahead. He must see far enough to be assured, not only that the portion of the passing lane he must use is clear when he starts passing, but that no vehicle approaching from the opposite direction will threaten him before he completes his maneuver and turns back into line. For design speeds of 50, 60, and 70 miles per hour the distance for both types should be, respectively, 1,600, 2,300 and 3,200 feet.

Such sight distances are difficult to provide, especially in rolling country. Modern highway practice prohibits passing on highway sections where curves, hills, or other conditions limit the view of the road ahead to less than these safe distances. These "no passing zones" reduce the working capacity of a highway. In the case of the 3-lane highway, they frequently result in considerable sections of the center lane being prohibited for use by traffic from either direction.

"No passing zones" are not established on 4-lane roads because there should be no need for passing vehicles to enter an opposing traffic lane. On these highways it is sufficient if the driver can see the passing lane for the distance required to bring his car to a halt. These distances for speeds of 50, and 60 miles per hour are, respectively, 350 and 475 feet. To distinguish them from the much longer safe passing sight distances required on 2- and 3-lane roads, they are called "safe stopping distances."

Passing and Highway Capacity

The degree of freedom and safety with which passing can be performed is the vital factor in determining highway capacity. The accurate determination of practical working capacities for different types of roads and the selection of the proper highway types to accommodate the various volume ranges are the most important steps in designing highways for safety. The 2-lane highway is, for obvious reasons, the basic highway type in Michigan and in the country at large. It is the minimum highway facility which will accommodate all the requirements of traffic up to its capacity limit. It comprises 90 per cent of our paved rural trunkline mileage. Other types are built only when the capacity for the 2-lane highway is exceeded. Much study has been devoted to learning what the limits of its efficient carrying ability are.

It has been found that on a 2-lane road with 150 vehicles per hour in the opposing lane, a driver can make two out of three passings without slowing down. But when there are 400 vehicles in the opposing lane, he can make such undelayed passings only once in three times. On the reasonable presumption that 400 vehicles in the opposing lane represents the maximum hindrance to free driving that drivers will tolerate, this quantity has been made the basis for estimates of 2-lane capacity. By placing 400 vehicles in each lane, the value of 800 vehicles per hour has been derived as the maximum possible capacity of these pavements.

30th Highest Hour Is Critical

However, this value is too high as a measure of capacity because experience shows that highway traffic does not normally flow with equal volumes in both directions. Particularly during peak hours, about two-thirds of total volume flows in one direction. Thus, when 400 cars are in one lane there will be 200 in the other lane, or a total of 600 vehicles per hour, this constitutes the practical operating capacity of a 2-lane highway. Above that volume, large numbers of drivers are encountering intolerable restriction of the passing maneuver.

Highway designers cannot and should not attempt to provide completely adequate capacity for every vehicle traveling a highway. They should provide for all but the highest volumes, however, and the 30th highest hour of the year has been selected by highway authorities as setting the limit to their responsibility. In Michigan experience, a highway with a traffic of 600 vehicles in the 30th highest hour of the year will have an annual average 24-hour daily traffic of just over 3,000 vehicles.

Studies of accident occurrence on 2-lane roads under varying conditions of volume substantiate this critical value. They reveal that the accident rate increases as volume increases up to 3,000 vehicles per day. Above that volume the rate declines quite abruptly, probably because lessened vehicular speeds cut down the number of the more violent collisions.

Three roadway types—the 3-lane, the 4-lane undivided, and the 4-lane divided—are available to replace the 2-lane roadway where traffic has exceeded capacity. It has been found that the practical working capacities of 3-lane and 4-lane undivided roads is 5,250 and 10,500 vehicles for the average 24-hour day. There is reason to believe that a carefully designed 4-lane divided highway can carry volumes of rural trunkline traffic as high as 14,000 vehicles per average day at reasonable speeds and with freedom of movement under controlled access basis.

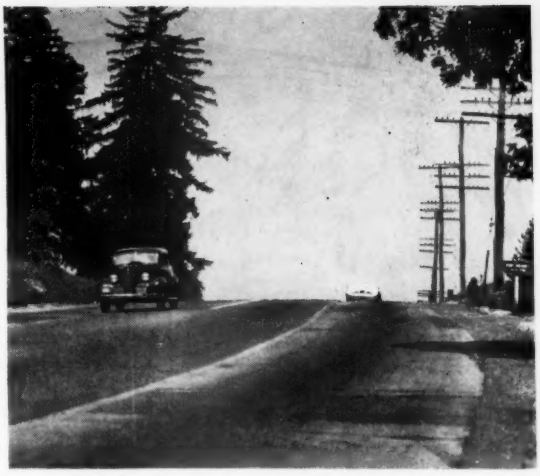
Accidents in Relation to Highway Types

A recently completed study of more than 22,000 accidents on the rural trunklines in Michigan gives considerable information concerning the relative desirability of these various highway types. The accidents occurred in the years 1936 to 1941 inclusive, a period of normal traffic. They cover more than 5,000 miles of rural highways. In many important particulars, the results parallel those obtained in prior studies based on less comprehensive data. This study found that the rates of accident occurrence per million vehicle miles on the four types of roadway were: 1.7 on the 2-lane; 2.0 on the 3-lane; nearly 2.5 on the 4-lane undivided; and 1.3 on the 4-lane divided.

The 2-lane roads' record for the more serious fatal and injury accidents is well below that of all other types except the divided 4-lane highway. The occurrence of only two kinds of accident—the noncollision and the fixed object accidents—is above the average on these roads. These are mostly "off the road" accidents, and the high rates are probably due to the fact that on 2-lane highways all vehicles travel next to the pavement edge.

The 4-lane undivided highway is indicated as the most hazardous type of roadway, with the 3-lane highway close behind. The 4-lane divided has by far the lowest rate of accident occurrence of any type investigated in this study. The rate for 4-lane undivided is nearly 90 per cent higher than the rate for the 4-lane divided. The rate for the 3-lane is 54 per cent higher. The divided type has a particularly marked advantage over these other two road types in the occurrence of head-on collisions, which are the most deadly kind of accident. The head-on collision rate for the 4-lane undivided is 460 per cent higher than for the 4-lane divided and that for the 3-lane is 390 per cent higher.

Narrow surface and inadequate sight distance.



Steep grades every three miles.

These findings regarding the relative accident producing characteristics of divided and undivided multi-lane highways are borne out by the reported experience in other states. Typical are the before and after records of accident occurrence on a New Jersey trunkline which was converted from a 4-lane undivided to a 4-lane divided highway. These show that the change in roadway type resulted in a 40 per cent reduction in total accidents and an 83 per cent reduction in fatal accidents.

From the point of view of traffic safety as well as of efficient traffic operation, the divided 4-lane is the most desirable type of highway to serve traffic volumes beyond the capacity of a 2-lane road.

Other Safety Features

The details of highway designing are constantly being developed and refined to better serve and protect traffic. Many of these details cannot be described in a short paper, but some of them require at least brief mention. Among these are lane width and pavement marking.

Experience with and study of traffic and vehicle behavior has led to a progressive widening of the traffic lanes. The early 8- and 9-foot lanes are now practically things of the past and 10 feet has been the minimum dimension for a number years. But with increasing volumes, greater speeds, and a tendency toward greater width of vehicles, the need for expanding the lane continues to be felt.

Justification for 11-foot and even for 12-foot lanes is found in observations of actual vehicle placement and accident records. On 2-lane pavements with 10-foot lanes, more than 20 per cent of commercial vehicles and 10 per cent of passenger cars normally travel with their bodies extending to the left of the centerline. Even when passing vehicles, nearly 4 per cent of trucks and 3 per cent of cars continue to trespass into the opposing lane. The number of intruding vehicles is found to be reduced by about 30 per cent

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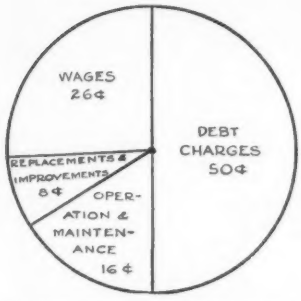


Where the water dollar goes.

Practical Water Works Operation Data from Detroit

What it costs to test and repair meters; filtration plant data; free chlorine residuals; the Water Department's accident prevention program.

THE annual report of the Department of Water Supply of Detroit, Mich., for the fiscal year ending June 30, 1946, has just been received. Though now more than a year old, much of the data in it are of value to other water works operators and superintendents. The problem confronting Detroit is illustrated by the tremendous amount of water used. The average day's pumping amounted to 301.2 million gallons, of which 148.3 mg. came from Springwells Station and 152.9 mg. from Water Works Park. The maximum day was June 25 when pumpage was 431.6 mg. The minimum day was 226.3 mg. The maximum hourly rate occurred on July 30, when an equivalent daily rate of 731.6 mg. was reached. Per capita consumption was 131 gals., compared to 141 gals. the previous year; and the average consumption per service per day was 677 gals.

Accident Prevention Program

The Department's accident prevention program, which is based on recommendations of the National Safety Council, is carried out under the general direction of the Safety Committee and under the immediate Supervision of the Safety Officer. Posters, literature and reminders were conspicuously posted, and were distributed at frequent intervals. Group meetings were held, at which safe working procedures were explained and discussed. The Safety Officer made regular inspections of working conditions, equipment and work procedures at the plants and yards and on construction projects. Correct personal protective devices were provided and employees instructed in their use and care. All reported accidents were investigated to determine the direct and indirect causes; steps were then taken to avoid recurrences. Reported hazardous condition in and around meter wells were investigater and corrections recommended. Manholes and underground installations were checked for explosive or dangerous gases, with the Fire Department.

Metering and Meter Repair

There were 329,741 meters in service at the end of the year, an increase of 2344. The meters vary in size from ⅝" to 24". The number of meters tested aggregated 34,903, or slightly over 10% of the total in use; and of these, 33,533 were ⅝" and ¾". The average cost of testing was 10½¢ for ⅝", 14¢ for ¾"; 28¢ for 1"; 95¢ for 1½"; $1.14 for 2"; $3.55 for 3"; $5.68 for 4"; $8.52 for 6"; and $9.94 for 8". The average cost of installing meters during the year is shown herewith in Table I.

The average cost of repairing meters damaged through various causes was as shown herewith in Table 2.

Table 1—Average Cost of Installing Meters

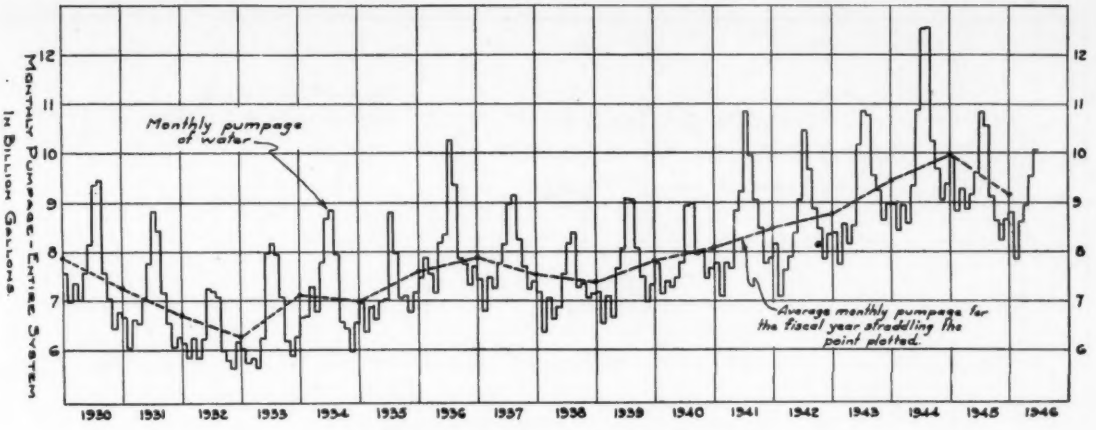
Size	*Labor, etc.*	*Materials*	*Cost*
⅝"	$0.72	$10.32	$11.04
¾"	.86	14.83	15.69
1"	1.26	22.00	23.26
1½"	3.70	43.41	47.11
2"	3.80	65.30	69.10

Table 2—Cost of repairing Meters

Size	*Labor*	*Material*	*Total Cost*
Damaged by Frost			
⅝"	$1.84	$0.75	$2.59
¾"	1.96	1.07	3.03
1"	1.99	1.38	3.37
Damaged by Hot Water			
⅝"	$1.82	$1.01	$2.83
¾"	1.94	1.61	3.55
1"	2.04	2.14	4.18
1½"	6.82	6.97	13.79
2"	7.47	8.29	15.76
Damaged by Wear and Tear			
⅝"	$1.87	$0.57	$2.44
¾"	1.95	.87	2.82
1"	2.03	.92	2.95
1½"	4.17	1.15	5.32
2"	4.90	1.13	6.03
3"	5.48	1.70	7.18
4"	7.01	2.18	9.19
6"	8.34	1.51	9.85
8"	8.22	.71	8.93

Water Purification Data

Purification of the water supply is accomplished at Water Works Park and Springwells by means of chemical coagulation with alum, sedimentation, rapid sand filtration and disinfection with chlorine. Regulation of these technical procedures is based upon the result of frequent and repeated analytical control tests of the water at various stages of treatment, which tests are carried out in the laboratories provided at each filtration plant. In general there were no abnormal conditions; the sanitary condition and mineral content of the water showed no marked changes, though the continued presence of organic industrial



Monthly and annual pumpage data, 1930-1946.

waste contamination of the river water was frequently indicated by medicinal tastes on chlorination of test samples, and at times by difficulty in obtaining a satisfactory floc with normal concentrations of alum. Preammoniation as a taste preventive and chlorine fixative was discontinued and reliance placed on higher concentrations of chlorine to produce "free" residuals. Experimentation indicated that this process will prove about as effective as chlorination for taste and odor control.

Water Works Park Plant.—At this plant there are 80 filters, each with an area of 1,088 sq. ft. The total rated capacity is 320 mgd. Sedimentation tanks provide a detention period of 2 hours. The average filter run between washings was 36 hrs., and the wash water amounted to 3.5%. The average rate of operation of the filters was 146.0 mgd. per acre. Daily average raw water turbidity varied from 3 to 39ppm., with a mean annual turbidity of 8 ppm. Average rate of alum application was 8.3 ppm. The MPN index of coliform bacteria in the raw water averaged 96. A maximum monthly index of 400 occurred in March and the minimum of 9 in May.

The average rates of chlorine application were 0.56 ppm. as pre-chlorine and 0.21 ppm. as post-chlorine, which was an increase of 47% over the previous year in pre-chlorine and of 4.5% in post-chlorine. The usual zero coliform index for the plant was maintained. For taste and odor control, hourly test samples of raw water are chlorinated in the laboratory with 0.42 ppm. of chlorine and tasted after intervals of 10 and 120 minutes. On 53 days during the year, chemical-medicinal tastes were detected, indicating the presence of phenolic or similar compounds in the river water. No tastes were observed in the finished water.

A better understanding of the so-called "chlorine demand" of the unprocessed raw water supply has been gained through repeated laboratory trials designed to measure chlorine residuals under controlled conditions of contact time, temperature, concentration of dosage, etc., all of which indicate that their influence is considerable; indeed not infrequently as important as the variation of the chlorine-consuming organic matter present in the water itself.

Springwells Plant—There are 68 filters at this plant, each with an area of 1,088 sq. ft., and the plant has a rated capacity of 272 mgd. Sedimentation tanks have a detention of 3 hours. Average filter run was 33 hrs., and wash water averaged 5.1%. Rate of oper-

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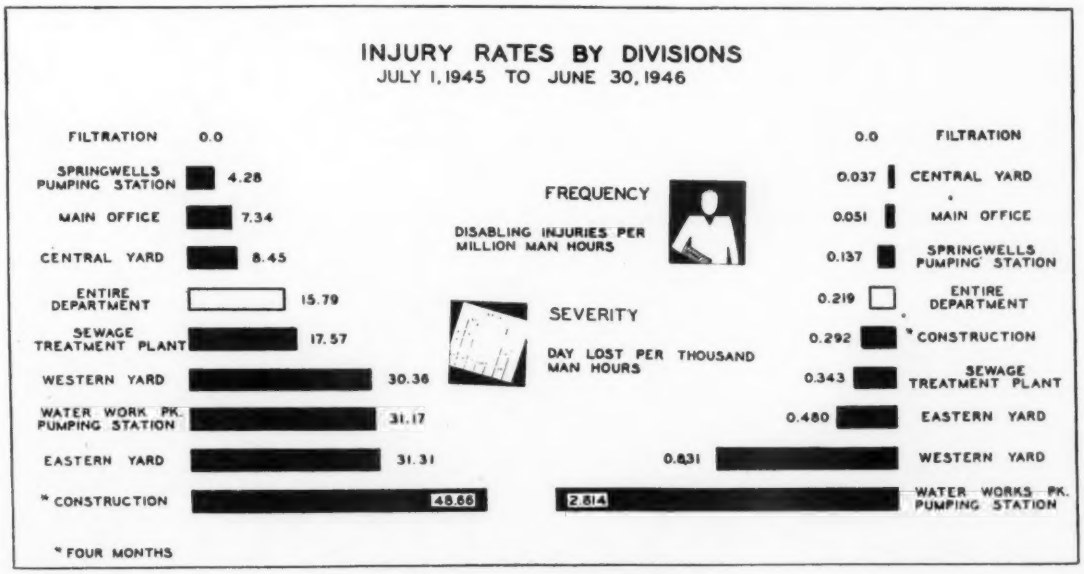
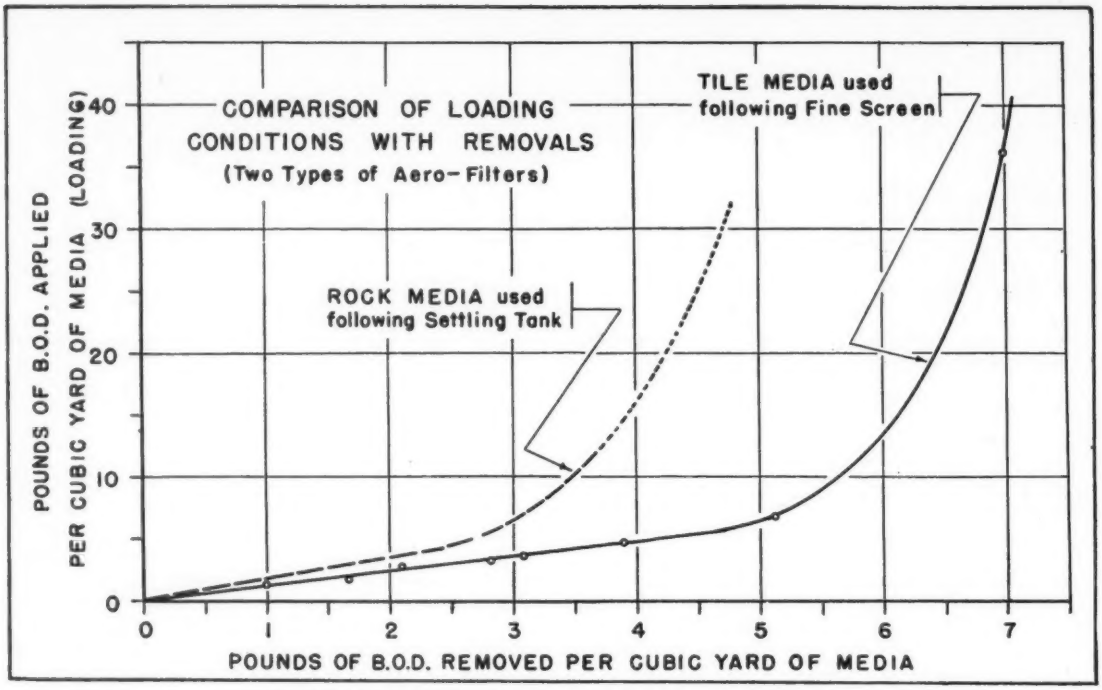


Accident data, Detroit Water Department.



Graph B—Comparison of rock and tile media loadings and removals.

The Treatment of Strong Wastes

The authors propose preliminary treatment with fine screens, the use of high-rate filters with special tile media, and vacuum filtration of chemically aided drying of sludge.

By A. W. BANISTER and R. J. ELLISON
Banister Engineering Co., Consulting Engineers, St. Paul, Minnesota

THE war years produced a rapid expansion in milk, vegetable, and meat processing in Minnesota and in northern Wisconsin. This section being dairy country, it was normal before the war to expect occasional strong wastes. Today, strong wastes are commonplace in this section and a weak waste (one with a ppm BOD below 300) is an exception rather than the rule.

Studying fifteen representative communities, nine in Minnesota and six in Wisconsin, we find that the average ppm BOD is 529. The following communities were used in the study. The design domestic waste population is the first figure; the design ppm BOD is the second figure.

Crookston Minnesota	8300	400
Farmington, Minnesota	2200	442
Foley, Minnesota	1260	610
Lindstrom, Minnesota	1000	356
Moorhead, Minnesota	19000	563
Pine Island, Minnesota	1300	880
Renville, Minnesota	1800	654
Rosemount, Minnesota	750	200
Winthrop, Minnesota	1800	452
Balsam Lake, Wisconsin	700	280
Barron, Wisconsin	2800	870
Cameron, Wisconsin	1200	615
Clear Lake, Wisconsin	1000	570
Dresser, Wisconsin	475	280
Ladysmith, Wisconsin	4800	765

It is probable that the more communities used for averaging purposes, the higher would be the average ppm BOD.

Milk and vegetable processing wastes are primarily in solution and both have a tendency to turn acid rapidly. Meat processing waste has a tendency to turn anaerobic quickly. Each of the three wastes tends to arrive at the treatment site in concentrated "slugs" during clean-up periods or at time of maximum production. In the case of milk processing plants, large volumes of sour milk can be, and have been, dumped into the sewer. This sour milk will readily break down into whey and casein, the casein being deposited in the various units of the plant. As the bulk of the organic material in these various communities is represented by concentrated industrial wastes, any treatment to be provided must generally be designed for these wastes with the treatment of the domestic wastes considered a minor incidental.

Treatment of milk processing waste prior to the war had been largely limited to the use of a holding (or metering) tank, with a capacity equal to the twenty-four hour flow, plus a low-rate filter followed by a settling tank. The filter size was usually based upon a loading of about 0.25 pounds of BOD per cubic yard of rock media. These plants have performed well but have four disadvantages:

(1) The deposition of casein in the metering tank

and on the filter produced periodic poor operation.

(2) The plants produced a high-strength effluent regardless of the excellent 85% removal of BOD.

(3) The exposed filters were odorous and provided fly nuisance.

(4) The cost of low-capacity filter treatment is high.

The advent of high-rate filtration of wastes during the immediate years prior to the war has since provided a material back-log of data as to expected performance, with satisfactory answers to most of the faults of the old metering tank and low-rate filter method. The use of recirculation of effluent provided partial solution of the pH control problem, recirculation having the effect of raising the pH as opposed to the acid tendency of the holding tank. Recirculation also provides a partial answer to the need for evening out the momentary wide variation in strength peculiar to these wastes. High-rate filters provide marked cost economy compared to the low-rate filter. Particularly where two-stage filtration is required, as is true in many of these cases, the cost of low-rate filters makes their use unfeasible.

The rock media filters did not provide the answer to two problems:

(1) When milk processing waste arrives at the treatment site in the whey-casein stage, it will precipitate on the filter or in settling tanks and plug a rock media filter.

(2) Rock media filters have a history of ponding (or clogging) for two to four weeks every year, and year-around operation is important.

To meet best the requirements for efficient and economical operation, we have recommended the use of the following units in the plants designed for the high strength industrial wastes described herein.

(1) A self-cleaning fine screen having ten meshes to the inch. This unit has four advantages:

(a) Initial retention of these wastes with their acid and anaerobic tendencies in a settling tank would be harmful rather than beneficial, and the fine screen provides immediate passage to the filter.

(b) The screen prevents pump and filter orifice plugging.

(c) The solids passing the ten-mesh screen will be treated in the microbial "forest" of the filter flora.

(d) The initial cost of the screen and area required for installation is extremely low.

The disadvantages lie in the use of a piece of mechanical equipment in continuous operation and the use of effluent water under pressure to keep the screen clean.

(2) The use of a tile media high-rate filter.

The tile media includes one-inch round holes extending vertically from top to bottom. It is a uniform material, permanent in character and self-cleaning. It will not pond. The normal design loading for a tile media high-capacity filter is about 3.33 pounds per cubic yard of media permitting the use of a unit less than 10% of the size of a low-rate filter. Because, in the case of high-strength wastes, the design is basically made on a "loading" basis and not on a

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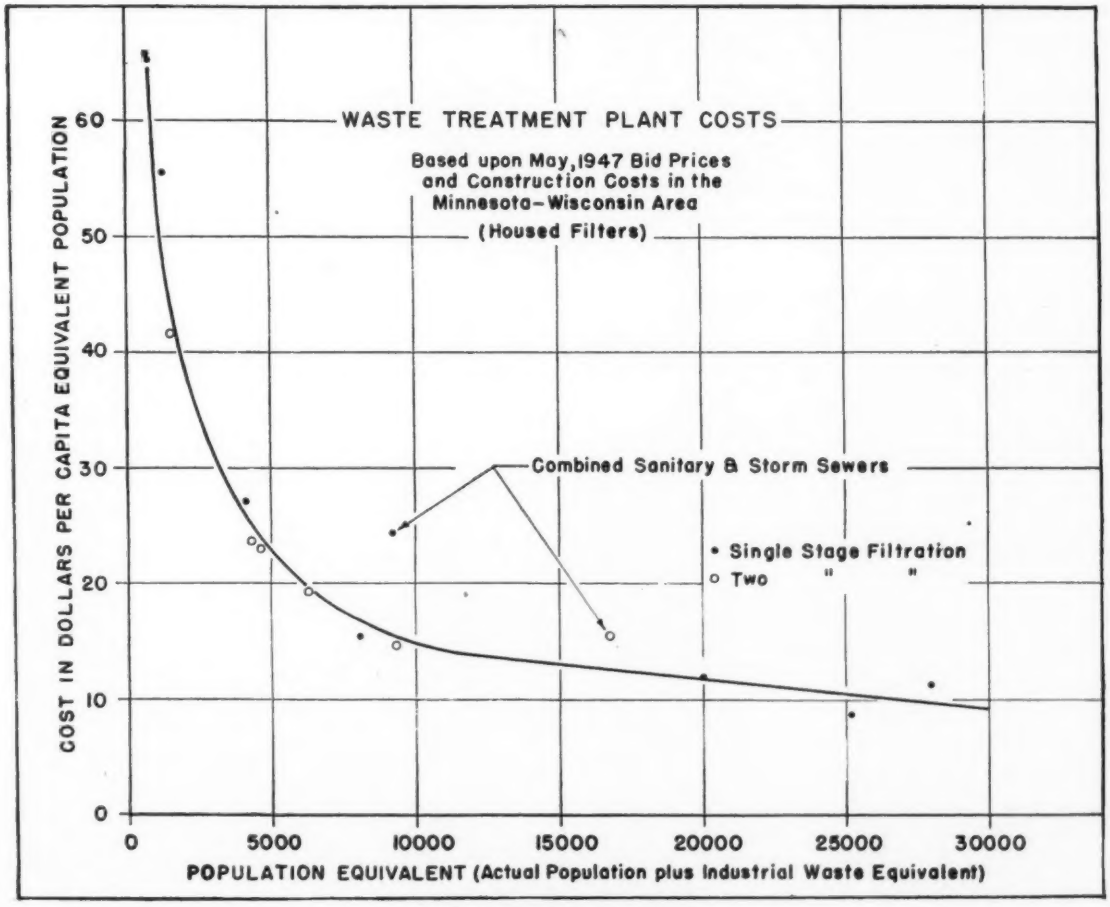


Graph A—Costs of waste treatment.

Remote controlled transmitter.

Washington Stat ligh
By 2-Way F Radi

How the Washington State Highway Department has increased the efficiency of its maintenance operations, speeded up snow removal, and given better service to the citizens.

By FRED E. EBEL

"DURING periods of emergency caused by heavy snows, washouts, slides and drifting snow, the element of time and quick distribution of equipment and men often becomes the major factor in the reduction of damages, costs, and possible loss of life."

So speaks Clarence B. Shain, Washington State Director of Highways, whose six-months-old radio communication system has greatly influenced "the element of time and quick distribution of equipment and men." He says, further: "2-way FM radiotelephone has become a necessary part of maintenance operation. It enables the Department of Highways to give a much faster and better service to the traveling public."

The public traveling in the State of Washington uses 3,900 miles of primary state highways, 2,100 miles of secondary state highways, and more than 1,600 bridges Much of this mileage is scenic, transporting the motorist through dense forests of Douglas fir and pine; leading him, too, into the Cascade Mountains where he can see such natural wonders as Mount Rainier, Mount St. Helens, and Glacier Peak.

Canyon of snow at Chinook Pass.

Easy and safe access to Washington's rugged beauty is not without toil. A never-ending maintenance program is vital in mountainous areas where weather changes occur with little or no warning and where rock and snow slides can imperil the safety of motorists.

How Radiotelephone Saves

A snow slide, for example, on February 2, 1947, might have exacted a grim toll of human suffering had it not been for the speedy intervention of 2-way radiotelephone. Forty people in twenty-five passenger cars and one bus suddenly found themselves trapped in a 2½-mile canyon of snow on Stevens Pass, when tons of snow slid from steep mountain sides, blocking both avenues of escape.

Present, however, was a highway foreman who lost no time using the 2-way radiotelephone mobile unit on his pickup truck. Soon the Ski Patrol was on its way with food and necessary supplies. Morale, which might have been desperately low under other circumstances, was high because the group could use the radio to relieve anxious relatives of any fears regarding their safety.

Though many of the radio system's uses are of a dramatic nature, the main function of communication operations is to expedite the innumerable run-of-the-mill tasks typical of any highway maintenance department.

A patch job, for instance, was on schedule at Price Creek, nine miles east of Snoqualmie Pass summit. A repair crew with hot oil waited at Ellensburg Division Headquarters for the order to make the 47-mile mountain ascent. Then came the report from the foreman at Price Creek: "Rainy weather makes oiling impracticable." To which the supervisor at Ellensburg immediately replied: "Go ahead with other work." Thus, in less than one minute an on-the-scene radio weather report forestalled a useless, time-consuming, man-power wasting trip.

Highway and Weather Reports

Highway and weather reports are extremely important in a country where a drive up a mountain pass can take one from sunny warmth to raging blizzard. Thus the necessity of the daily morning radio weather network which speedily gathers weather conditions from the four corners of the state. This information is passed on to the public through hotels, local radio sta-

Highway Maintenance Speeded by FM Radiotelephone

tions, and the AAA. Many comments of appreciation have been received by the department for this service rendered through the medium of 2-way radiotelephone.

Snow, of course, is the Highway Department's No. 1 weather problem. Long stretches of lonely road complicate the maintenance picture. Some of the "runs," for example, that a snow plow operator must make are 50 miles long. An operator can approach the end of his run totally unaware that 9 inches of snow have fallen miles behind him. With 2-way radiotelephone this man can be called back. Without radio he would be ignorant of the fact that his initial efforts had failed to open traffic.

Snow drifts are common and not only play havoc with the motorist, but also, at times, endanger the safety of highway personnel. Not long ago a 10-ton Oshkosh with V-plow attached became stuck in a drift. A faulty fuel line made it necessary for the operator to leave his cab. A few minutes work over the engine in 20-below-zero weather resulted in four frozen fingers on one hand, three on the other. He made his way back to the cab and radioed for help. There remains little doubt that this man was saved from grave exposure and possible death due to speedy help obtained through 2-way radiotelephone. In this case, the marooned man was 50 miles from district headquarters. Yet, once he had transmitted the message, he sat back in the relatively comfortable knowledge that help was on the way.

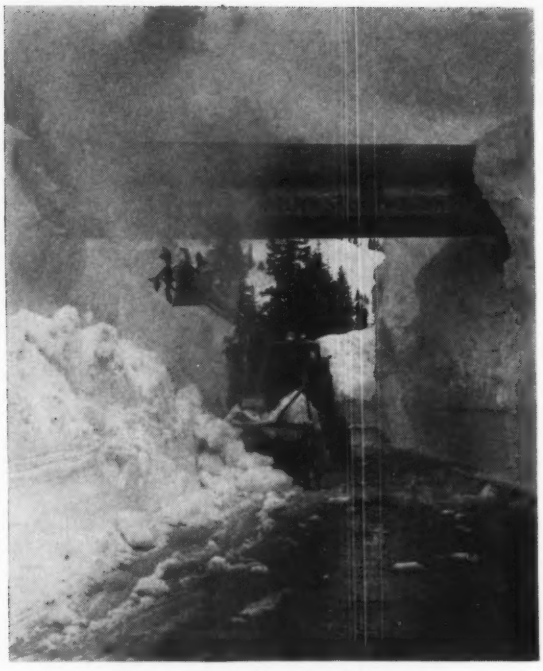
The incident serves to illustrate the powerful effect of 2-way radiotelephone on the morale of personnel. Men working under hazardous conditions work more efficiently in the knowledge that regardless of weather and road conditions they are no further from headquarters than the few feet to the dashboard microphone.

The Radiotelephone System

Heading the radio communication system's technical department is radio engineer Clair Lewis. Young and imaginative, he and his assistants have installed, in the remarkably short time of six months, thirty-six 2-way FM Motorola radiotelephone mobile units on rotary plows, push-plows, pickup trucks, and administrative cars.

Thirteen Motorola FM main stations are strategically located on natural high elevations at Wenatchee, Blewett Pass, Okanogan, Olympia, Tacoma, Vancouver, Chehalis, Raymond, Goldendale, Satus Pass, Yakima, Ellensburg, and Snoqualmie Pass. The capital city of Olympia is the "brain center." From the dispatching office in the Transportation Building, a telephone wire one and one-half miles long extends to a hill in the suburb of Tumwater, there to actuate a 250-watt frequency modulated Motorola transmitter. The remotely controlled transmitter can send messages as far east as Goldendale and Wenatchee, airline distances exceeding 100 miles. Emergency power is obtained through the use of gas-electric units which switch in if the main power lines fail. So rapid is this transition that not a syllable is lost.

Maintenance supervisor radios work progress to district headquarters.



Radio controlled rotary in Chinook Pass.

Wherever possible high terrain has been utilized for transmitter sites. In a territory with such giants as Mount Rainier, elevation 14,408 feet, very little difficulty has been experienced in obtaining altitude. Lewis' method of surveying possible station sites is an example of resourcefulness. An accomplished airman, he flies parallel with mountain peaks and records elevations of likely sites from the ship's altimeter. An example is Birch Mountain, transmitter site for the Wenatchee district headquarters. Ten miles of telephone wire wind up to the mountain transmitter, capable of "talking out" 135 miles over valleys and peaks.

Wenatchee, the "Apple Capital of the World," lies in a valley at the foot of the Cascade Mountains. Surrounding the city are such scenic—but radio plague areas!—as Stevens Pass and Lake Chelan. In many cases these mountains have acted as radio reflectors. Canyons help to "pipe" radio waves to various mobile units and stations.

How the radiotelephone helps in highway maintenance and in other ways will be shown in the concluding installment in the October issue.

Strong Waste Treatment

(Continued from page 27)

"flow" basis, recirculation can be included in the design without increasing the size of the filter, other than a very minor increase required in some States for including in the computation the organic material in the recirculated liquor. The tile media meets the requirements of eliminating the deposited "casein" hazard and overcomes the ponding difficulties of rock media filters.

The small size of the tile media high-rate filters permits economical housing of the filter, thus providing odor control, fly control, and better treatment during the winter months.

(3) The filter will be followed by the conventional settling tank and, in case an effluent consistently below 50 ppm is required, a second stage of high-rate filters using rock media on the low strength, well aerated first filter effluent.

(4) None of these industrial wastes is particularly well suited to treatment by digestion. Both milk and vegetable processing wastes have strong acid tendencies. In the larger communities, over 5000, we have recommended the use of a small sludge storage tank and vacuum filtration, and in the smaller communities, the use of direct chemical dewatering on sand beds. This method has the advantages of low initial cost, ability to handle a heavy overload without breakdown in the treatment, practical elimination of odor and satisfactory treatment of the various industrial wastes not suitable for digestion.

Graph "A" is a tabulation of costs including present price conditions, housing of the filter and the general method of treatment herein outlined. Graph "B" shows the comparison of rock and tile media loadings and removals on high-rate filters.

Detroit Water Works

(Continued from page 25)

ation was 138 mg per acre per day. Average rate of alum application was 7.9 ppm. with an average raw water turbidity of 7 ppm. Chlorine was applied at an average rate of 0.60 for prechlorination, and 0.21 ppm. for post-chlorination. Only one coliform tube confirmed of 10,950 ten ml. portions tested. Medicinal taste of a pronounced nature occurred on 46 days. Carbon was added at these times, and also in the late summer and fall months to remove an earthy odor in the raw water. In all, carbon was used 184 days, with an average dosage of 0.64 ppm.

Other Activities and Developments

Water waste surveys covered 407 miles of mains and discovered 4 main leaks, one hydrant connection leak and 42 service connection leaks. The total leakage discovered was estimated at 1.8 mgd.

The city has undertaken to have the various departments prepare for the Board of Wayne County Highway Commissioners and the Michigan State Highway Department contract plans and specifications for city-owned ultilities in connection with the design and construction of proposed expressways. For both the John C. Lodge Expressway and the Edsel Ford Expressway, the principle has been established that, so far as practicable, work pertaining to the water system will be incorporated in the construction contracts for the expressways.

A new method for controlling pressures throughout the distribution system was initiated in June, 1945. This method involved the controlling of station pressures in accordance with information obtained from observers located at critical places in the distribution system. It operated satisfactorily, but it was decided that control could be obtained more economically by the installation of long distance pressure gauges for the transmission of presures from the critical areas. Studies were made, available equipment investigated, and plans developed for the installation of such a system, including the possibility of installing indicating instruments in the main office.

An experimental cathodic protection system was installed on the hot water tank in the basement of the main office building. Inspections five and six months after installation indicated that the interior surface of the tank had been well protected.

Results of Chlorination of Army Water Supplies

By CHARLES C. SPENCER

Assistant Professor of Sanitary Science, Columbia University School of Public Health; formerly Major, Sn. C., Sanitary Engineer, Office of the Surgeon, Second Service Command.

DURING the rapid expansion of the Army in 1941 and 1942, it was necessary to provide many new water supplies and to improve and expand others to meet the greatly increased demands. In some cases new sources were developed, but in perhaps the majority of instances necessary supplies were purchased from cities or private water companies in the vicinity of proposed bases.

Established Army standards for the bacteriological and chemical quality of water were strict and in accord with civilian standards in most respects. However, experience abroad with the effect of the newer methods of warfare on civilian communities and particularly on public water supplies made it evident that exceptional precautions would be required to maintain these utilities in a satisfactory operating condition should this country be subjected to aerial attack or to sabotage. Under the leadership of State and Federal health agencies, local waterworks authorities were organized, with the active cooperation of the services, to prepare for any emergencies that might arise.

It was recognized that disruption of water service, which might occur in wartime from broken mains, damaged treatment works, or the changed hydraulic conditions due to demands for fire fighting, would increase the opportunities for contamination from sewage or similar causes. In addition, it was necessary to consider possible deliberate contamination of supplies with pathogenic bacteria or chemical poisons.

It was evident that ordinary methods of laboratory control would offer little protection under any of these emergency conditions. Frequently two days or more may elapse between collection of bacteriological samples and the appearance of non-potable results in the laboratory. Furthermore, standard laboratory procedures would not reveal the presence of many types of pathogenic bacteria, poisons, or other substances deliberately injected into the system. For these reasons, outbreaks of disease or poisoning could occur before laboratory tests indicated danger.

The Advantages of Chlorination

The universal chlorination of water supplies suggested itself as the most practical safeguard to be used in overcoming these difficulties. Experience in its use and equipment for its application were available. It could be relied upon to react with and destroy almost any type of contaminant entering the supply while at the same time any sudden change in the residual chlorine in the system would serve as an immediate indication of the entrance of contamination or of any other condition requiring prompt investigation.

It had long been accepted that the presence of small amounts of free available chlorine throughout a water distribution system was desirable as a continuous indication of safe quality and that it provided also some protection against pollution entering through back-siphonage, cross connections, or repairs to the system.

Practice in chlorination varies greatly throughout the country. Used alone or in conjunction with ammonia, dosages range from a few tenths to over fifty parts per million. Chlorine demands vary with the characteristics of the water, the time of year, type of distribution system, etc. It is, therefore, difficult to propose a standard amount of residual chlorine for a large number of supplies spread over an extensive area. Under wartime conditions, however, it was believed necessary to require a specified amount of residual chlorine in Army water supplies. Reasons included: higher water demands, changes or extensions in the systems, unknown factors concerning some of those being used for the first time, and the effect of sudden increases in water demand on main deposits. These circumstances often resulted in unsatisfactory laboratory results.

Requirements for Chlorine Residual

The many wartime uses of chlorine made it a material of increasing scarcity, and consideration was given to establishing the minimum dosages that would provide reliable treatment and assure safety for military installations. After consultation with health agencies and waterworks authorities, fixed camps and stations were instructed in November, 1942, to provide a residual of 0.4 p.p.m. of chlorine in all parts of the system in active daily use. This requirement caused difficulty in systems provided with excess main capacity for fire protection where routine demands were low, and in other special cases it appeared impractical to maintain the stated residual. Instructions were, therefore, modified in July, 1943, to require 0.4 p.p.m. after 30 minutes contact between the chlorine and the water. This did not normally apply to supplies purchased from municipalities which themselves provided acceptable treatment and control. However, all waters used in Army installations were required to be satisfactorily chlorinated at some point before use.

It is of interest to note that while free chlorine residuals were not specified by the 1942 requirement, the dosage required was such that in many cases a free residual was obtained.

Following four years of experience with this policy of strict chlorination, it is of interest to inquire what benefits have accrued.

The prevention of water borne disease is the primary reason for water treatment. Unfortunately, the operations carried on by the Army during the period concerned has been subject to such a myriad of influences that any precise correlation between the incidence of possible water-borne diseases and water supplies is not possible. It may be that some cases of gastro-intestinal diseases due to water have occurred, among troops in fixed installations in this country, which were not sufficiently acute to require treatment or did not provide a well defined epidemiological picture per-

mitting them to be recorded as outbreaks. Nevertheless, the reporting of communicable disease among troops was carefully carried out, and it is significant that during the period 1942 to 1947 no outbreaks of water borne disease were recorded at Army installations in the continental United States.

During 1942, 1943, and 1944 the state health departments reported to the United States Public Health Service a considerable number of outbreaks of water borne disease in civilian communities. Ten of these, with a total of about 4,500 cases, were reported due to inadequate, irregular, or interrupted chlorination of public water supplies.

It appears reasonable to assume that the chlorination practices outlined above were of assistance in maintaining the good record of freedom from water borne disease in the Army.

Army Laboratory Records

The effectiveness of control measures can also be determined from laboratory records. In the Second Service Command a central laboratory in New York City examined water samples from all of the Army installations in New York, New Jersey, and Delaware. Many of the larger posts also examined their own samples submitting only check samples to the central laboratory. In some cases samples from outlying stations were in transit for excessive periods of time and sometimes were collected by individuals with insufficient training in this type of duty. When non-potable samples were secured from any point, instructions were issued to resample the same point until potable results were secured, corrective measures meanwhile being applied. The resampling procedures sometimes had the effect of increasing the percentage of non-potable samples reported. For this and other reasons, the overall result of examinations made for Army Camps in the area cannot fairly be compared with the standards for water quality set up by the U. S. Public Health Service and the American Water Works Association. In most cases, however, monthly records showed a very low percentage of non-potable samples. Occasionally a temporary rash of samples containing B. Coli would be secured from a station where repairs or additions were being made to the distribution system.

Improper collection procedures were frequently blamed for the appearance of non-potable samples. However, in the stations having the greatest number of bad samples it was generally possible to point to some sanitary defect in treatment or distribution as a contributing factor. Correction of such deficiencies was almost always followed by satisfactory laboratory results.

Ed. Note: During 1944 and 1945, the Army examined and reported on about 240,000 water samples from installations in the Continental United States, and considerably less than 2% were reported as non-potable.

Sewer Rental Data

(Continued from page 20)

use. The rate in Ardmore is 75¢ inside and 1½ as much outside; in Muskogee, it is 40% more outside; and in Tulsa, $9 per residence per year outside.

Oregon—Six replies. Milton City charges on a flat rate basis, Corvallis on a percentage of the water bill and Portland on water use. Milton City charges $1 per month inside and gives no service outside the city limits.

Pennsylvania—Fifty replies. Nine cities report sewer rentals. Five — Waynesboro, Phoenixville, Abington, Ambler and Lower Merion charge on the basis of plumbing fixtures, Jeanette on water use, Wilson Boro and Philadelphia on a percentage of the water bill and Swarthmore on a flat rate. Swarthmore charges $2 per family per year; in Meadville the charge outside is about double the amount of taxes inside; in Phoenixville, the outside rate is 50% more.

Rhode Island—Four replies. No city reports charging rentals inside the city. Newport charges $6 per year for outside service.

South Carolina—Nine replies. Newberry charges a sewer rental based on the number of plumbing fixtures. Camden is likely to initiate a charge soon.

South Dakota, three replies and *Tennessee*, seven replies, none of which charge rentals.

Texas—Twenty-seven replies. Twenty-three cities report charging sewer rentals. Six—Highland Park, Denison, Lampasas, Nacogdoches and Navasota—are on a flat rate, 14—Abilene, Albany, Belton, Brownwood, Harlingen, Hearne, Longview, Orange, Paris, Temple, Tyler, Victoria, Borger and Amarillo, with modifications—base the charge on the number of plumbing fixtures, and Corpus Christi, Giddings and Marshall are on a water use or percentage basis. Abilene uses the money received as a general fund item; Brownwood, Amarillo, Paris and Victoria charge double as much for outside service; Longview, Marshall, Harlingen and Temple charge 150% of the inside rates for outside service; Corpus Christi has a minimum charge of $1 per month; Denison charges 25¢ per month; Freeport includes the sewer rental in the water bill. Borger charges 50¢ for 5 fixtures and 5¢ for each additional fixture in residences; more for businesses.

Utah, three replies, and *Vermont*, six replies, none charging rentals.

Virginia—Seventeen replies. Seven cities collect sewer rentals in Virginia—two—Martinsville and Radford—on water use, three—Farmville, Pulaski and Winchester—on the basis of plumbing fixtures, and two—Altavista and Williamsburg—on a flat rate. Outside the city charges are reported as follows: Danville, $6 per year; Farmville, $3 for one family, $5 for two; and Martinsville, 50% more.

Washington—Nine replies. Renton charges on a flat rate basis and Pullman on a water bill percentage. Wenatchee charges $400 for an outside sewer connection.

West Virginia—Four replies, none charging rentals.

Wisconsin—Twenty-five replies. Sturgeon Bay and Hartford charge on a water use basis and three—Madison, Oshkosh and Stevens Point on a percentage of the water bill. West Bend charges for outside service $2 per $1,000 assessed valuation; Stevens Point charges 70% of the water bill; Oshkosh rates include a fixed charge of 40¢ per quarter, with a sliding charge based on water use. The minimum bill is $1.15 per quarter.

Wyoming—Three replies, none of which charge rental.

Municipal Water Use 1.5% in Charleston

The total water pumped to the city mains by the Water Department of Charleston, S. C., in 1945, amounted to 5,141.9 million gallons. The water furnished city institutions and used for street cleaning and sewer flushing amounted to 9.9 million cubic feet, or about 1.5% of the total pumpage.

How to Design Imhoff Tanks and Trickling Filters for Schools, Camps and Hotels

ADEQUATE treatment of sewage is generally necessary before it can be discharged into a stream or ditch. For the "in between" jobs—those too large for septic tanks and subsurface disposal and too small for standard mechanical equipment—an Imhoff tank and trickling filter will often prove highly satisfactory. The following data on design for these small installations are taken from a publication of the Division of Sanitation, H. M. Bosch, director, Minnesota Department of Health.

Sewage Flows. The following per capita flows represent good practice in design but should be checked with your own State Department of Health: Schools, 10 gals. per 8-hr. day; camps, 25 gals. per day; cottages or groups of cottages, 40 gals. per day; hotels, lodging houses, restaurants and boarding houses, 75 gals. per day; institutions, 100 gals. per day or more.

Imhoff Tank Design. A suggested Imhoff tank design is shown in Fig. 1. The detention period of the settling chamber should be 2 hrs.; the length of the tank may be 1½ to 3 times the width; there should be baffles across both inlet and outlet ends; the gas vent should be at least 2 ft. wide; and the settling chamber walls should be sloped 1.5 vertical to 1 horizontal. Suggested dimensions of small Imhoff tanks for various purposes and population loads, based on providing adequate sludge storage and digestion capacity, are shown in Table 1.

Table 1—Imhoff Tank Dimensions

Number of Persons Served	*Dimensions—See Fig. 1.* W	B	C	L
For Schools				
60-100....	5'0"	4'9"	3'0"	8'0"
100-150....	5'6"	5'3"	3'9"	8'0"
150-200....	6'0"	5'9"	4'6"	8'0"
200-250....	6'6"	6'3"	5'3"	8'0"
250-300....	6'6"	6'3"	5'3"	9'0"
300-350....	6'6"	6'6"	5'3"	10'0"
350-400....	6'6"	6'9"	5'3"	11'0"
For Camps				
45-100....	5'0"	6'3"	3'0"	10'0"
100-150....	5'6"	7'6"	3'9"	10'0"
150-200....	6'0"	8'6"	4'6"	10'0"
200-250....	6'0"	8'9"	4'6"	12'0"
For Cottages				
25- 50....	5'0"	5'6"	3'0"	8'0"
50-100....	6'0"	7'0"	4'6"	8'0"
100-150....	6'6"	8'0"	5'3"	8'0"
150-200....	6'6"	8'0"	5'3"	12'0"
For Hotels				
15- 50....	5'6"	5'6"	3'9"	9'0"
50-100....	6'6"	6'3"	5'3"	11'0"
100-150....	7'0"	7'3"	6'0"	12'0"
150-200....	7'6"	7'9"	6'9"	13'0"

Trickling Filters. These consist of a bed of crushed stone, the pieces being about 1½" to 2½" in size, over which the effluent from the settling tank is distributed, either by fixed nozzles, small rotary distributors or tipping troughs. The editor will forward data on request covering small rotary and fixed nozzle distributors. Trickling filters should be 150 ft. or more from habitations or main roads, and it is highly preferable that they be covered. The filter should be designed on the basis of 2 gals. of settled sewage per hour per sq. ft. of filter surface. Depth should be about 6 ft. When tipping troughs are used, the portion of the filter dosed from one trough should not exceed 5 ft. on either side of the trough and trough length should not exceed

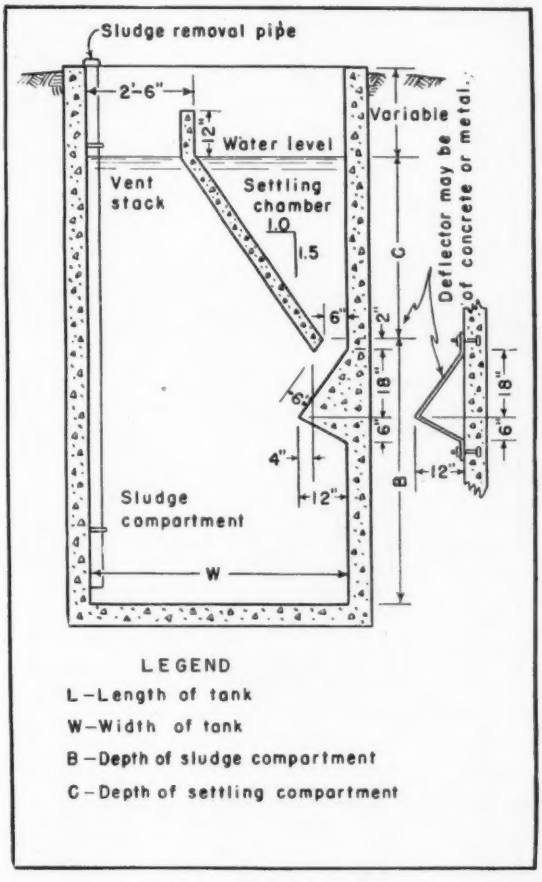


Fig. 1. Imhoff tank details.

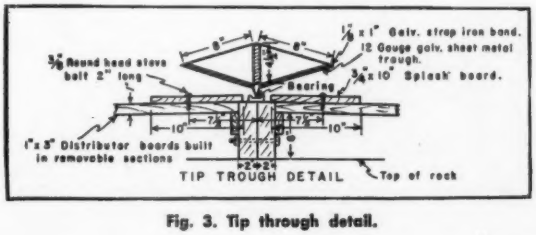


Fig. 3. Tip through detail.

14 ft. In other words, one trough cannot be used for a filter larger than 10 ft. wide and 14 ft. long; multiple troughs may be used for filters up to about 500 sq. ft. (Ed. Note: Small rotary distributors and fixed nozzles are considered superior for all but the smallest filters).

Table 2 herewith shows dimensions of trickling filters 6 ft. deep to serve various population groups.

Table 2—Trickling Filter Dimensions in Ft.

Number of Persons Served	*Rectangular Length*	*Width*	*Round Diameter*
For Schools			
100	8′	8′	10′
100-150	10′	10′	12′
150-200	13′	10′	13′
200-250	16′	10′	15′
250-300	16′	12′	16′
300-350	16′	14′	18′
350-400	16′	16′	'19
For Camps			
100	10′	8′	11′
100-150	12′	10′	13′
150-200	16′	10′	15′
200-250	16′	12′	16′
For Cottages			
50	8′	8′	10′
50-100	13′	10′	13′
100-150	16′	12′	16′
150-200	16′	16′	19′
For Hotels			
50	12′	10′	13′
50-100	16′	15′	18′
100-150	20′	18′	22′
150-200	24′	20′	25′

Final Settling Tanks. The effluent from the filter should discharge into a final settling tank, which may be of the rectangular type, with a baffle at either end.

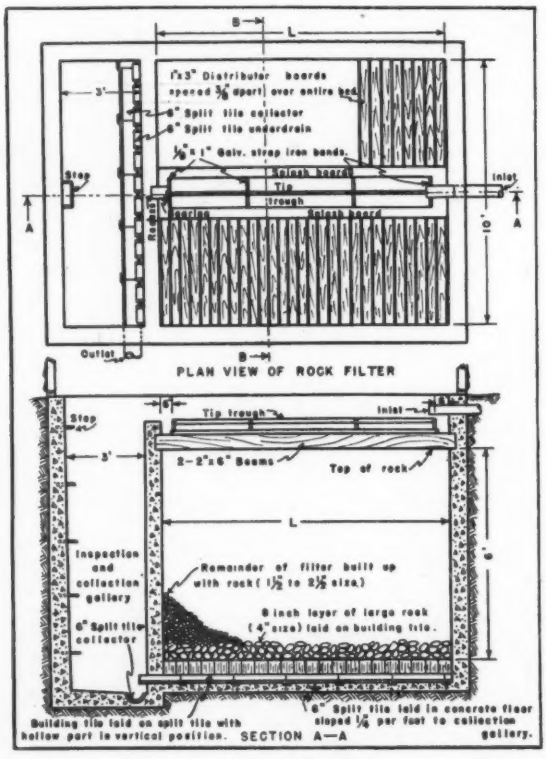


Fig. 2. Small trickling filter.

Capacity should be about 0.75 cu. ft. per person served; length should be about twice the width. Suggested dimensions are shown in Table 3.

Table 3—Size of Final Settling Tanks

Persons Served	*Length*	*Width*	*Depth*
50-100	6′	2.5′	5.0′
100-150	7′	3.5′	5.0′
150-200	8′	4.0′	5.'0
200-250	8′	4.5′	5.5′
250-300	9′	4.5′	5.5′
300-350	9′	5.0′	6.0′
350-400	10′	5.0′	6.0′

Other Details. The effluent should usually be chlorinated; for details and suggestions consult the State Board of Health. Several solution feed type machines are available. The use of pumps should be avoided wherever possible because of the operational care and maintenance required. If pumping is necessary, it is better to pump treated than raw sewage.

Modern Highway Design Reduces Accidents

(Continued from page 23)

on roads with 11-foot lanes and by about 50 per cent on 12-foot lanes.

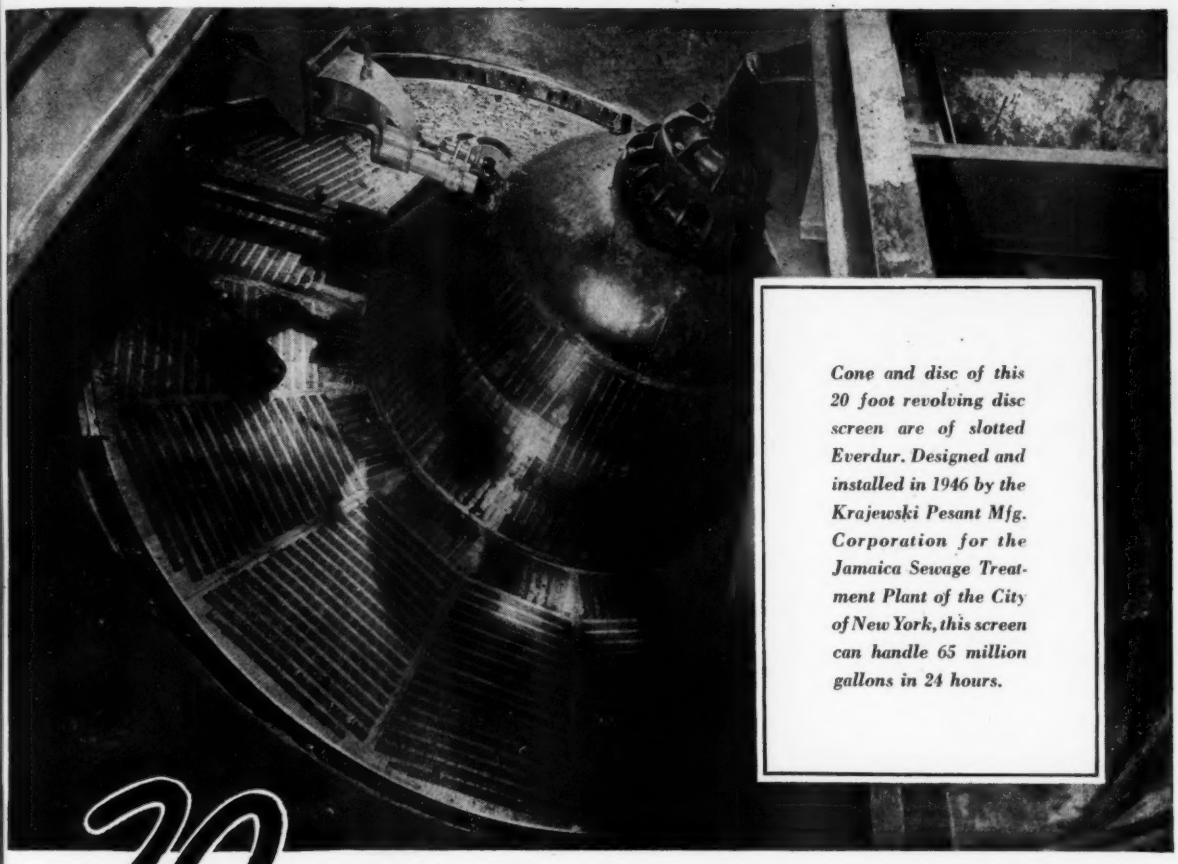
The better separation of opposing traffic permitted by more ample traffic lanes is reflected in accident experience. The rate of accidents per million vehicle miles has been found to be reduced progressively with widths from 18 feet to 23 feet and over.

Encroachment into the opposing lane can be controlled to a great extent by marking the center line of the 2-lane pavement. A system of pavement markings to accomplish this purpose and to prohibit passing and overtaking maneuvers in sections where sight distance is restricted has been worked out and has attained a promising degree of standardization among the states. Such marking in combination with signs is an effective safety practice.

Preservation of Safety Characteristics

Highway engineers can design and operate highways that should be safe, convenient and economical for highway transportation. However, the continued enjoyment of these values cannot be assured unless they are protected by obtaining right of way on a controlled access basis. This is a problem of very real significance. The safety characteristics of our trunkline highways are being depleted by the rapidly expanding developments along the roads. This is particularly apparent in the vicinity of the cities and in intensive resort areas. These roadside developments create an increasing number of intersections, wide entrance driveways, parking strips, mail-boxes, and other features that interfere with the free flow of traffic. Signs and lighting devices distract drivers attention and multiply the hazards.

Some engineers believe that this roadside exploitation is depleting the ability of our trunkline highways to serve traffic safely and conveniently, faster than we are able to build new roads. The highway engineer has designed and is building arteries with very high safety and efficiency standards. In the interest of the motorist who pays for these roads, we must find and use practical remedies that will preserve their safety and operational characteristics for his protection and enjoyment.



Cone and disc of this 20 foot revolving disc screen are of slotted Everdur. Designed and installed in 1946 by the Krajewski Pesant Mfg. Corporation for the Jamaica Sewage Treatment Plant of the City of New York, this screen can handle 65 million gallons in 24 hours.

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When you need special information—consult the classified READERS' SERVICE DEPT., *pages 69-73*

Public Works Engineering Methods and Data

Tar Surface Dressing for Wood Block Pavement

Quite a few cities still have wood block pavements in use. The following recommendations for surface dressings are based on full-scale road trials and experiences in England, using tar. The aggregate should be a hard, tough, clean crushed rock. For the first dressing, ⅜" should be used, and ½" for the second dressing. For early summer and fall, the tar should have a viscosity (BRTA) at 30°C of 80 to 100; and for summer work, 100 to 150.

All existing bituminous material should be removed so as to present a clean wood surface. This is preferably done by burning off with a road heater. It is important that the surface of the wood should be dry and the dressing should be commenced only after a period of warm dry weather. Before work begins the surface should be thoroughly cleaned by brushing, particular care being taken to clean the edges of the road.

The tar should be applied by a distributor, and the temperature during application should be between 200° and 260°F. For the first dressing, application of tar should be made at the rate of 7½ sq. yds. per gal. (about 0.13 gal. per sq. yd.). The ⅜" stone should then be applied uniformly at the rate of 100 to 120 sq. yds. per ton (16½ to 20 pounds per sq. yd.). When the first dressing has been well bedded down by traffic, excess stone should be swept off and the second dressing placed. For this, the tar should be applied at the rate of 6¼ sq. yds. per gal. (about 0.16 gal. per sq. yd.), followed by the ½" stone at 80 to 90 sq. yds. per ton (22 to 25 lbs. per sq. yd.).

The surface should be rolled after each application, using an 8 to 10-ton roller. Traffic should be kept off both the first and the second dressings for at least 12 hours after completion of rolling.

Water-Borne Typhoid in California from Untreated Water

Fourteen cases of typhoid occurred among the 200 users of a water supply at Almaden, Calif. The probable source of infection was an untreated creek water supply. The danger of this supply, which was not subject to state control because of its small size, had been recognized for 17 years. In 1936 safe operating procedures recommended by the state were put into partial effect. At that time chlorination was provided, but at the time the epidemic occurred, chlorination was not being carried on. This was the first water-borne typhoid outbreak to occur in California in more than 10 years.

Detroit Sewage Disposal and Water Rates

The basic rates for residents for water is 78¢ per 1000 cu. ft. for the first 10,000 cu. ft. and for sewage 11¢, making a total of 89¢. In addition there is a monthly service charge of 24¢ for a ⅝" meter, 36¢ for a ¾" and 72 cents for a 1". Suburban rates are slightly higher, being 82¢ per 1,000 cu. ft. for the first 10,000 cu. ft. and 25¢ for sewage disposal; and the service charges are 50¢, 62¢ and 98¢ for ⅝", ¾" and 1" meters respectively. Service charges are higher for larger meters, and the water rate decreases if more than 10,000 cu. ft. per month are used, but the sewage disposal rate per 1,000 cu. ft. does not change, remaining at 11¢ per 1000 cu. ft. for residents and 25¢ for those outside of the city limits.

The Longest Stretch of Straight Road?

What is believed to be the longest stretch of straight road in the world has been built by the Central Roads Department of South-West Africa.

During the foot-and-mouth disease epidemic, the roads department was called upon at short notice to build a road capable of carrying motorized transport along the border between South-West Africa and Bechuanaland. The road was considered necessary for the maintenance of an adequate police cordon.

A 300-mile road was cleared, levelled and graded within six weeks. One section runs as straight as a die, without the slightest turn or bend, for 180 miles.

From end to end, the 300-mile road has only two curves. It will not be opened to the public, being exclusively for the use of the police force.—*South African Municipal Magazine.*

Cost of Laying Water Pipe in Little Rock, Ark.

The Water Department of Little Rock, Ark., purchased during 1946, a Barber-Greene trenching machine, a tractor shovel, and a low bed trailer. These were used in laying mains.

During 1946, 18,627 ft. of 2-in. wrought iron and steel extensions were made at an average cost of 96c per foot, of which about 55c was for labor, and the remainder for material. The cost of 601 ft., 2 jobs, of 3-in. cast iron pipe, averaged $1.28 per ft., of which 54c was for labor. The cost of 4,916 ft. of 6-in. cast iron pipe extensions averaged $2.78 per ft., of which $1.50 was labor cost. For 8-in. cast iron pipe, the average cost for 3,697 ft. was $3.91 per ft., and for 10,775 ft. of 10-in. the average cost was $3.21 per ft. Labor costs on the 8-in. averaged nearly $1.90 per ft., and for the 10-in. about $1.50. The cost for 11,232 ft. of 12-in. Transite pipe averaged $4.64 per ft., the labor cost being about $1.63 per ft.

Oglesby Has 12.36% Unaccounted for Water

The municipal water department of Oglesby, Ill., reported that for the year ending May 1, 1947, unaccounted for water amounted to 12.36% of the 90 million gallons pumped. Since fire usage is not metered or otherwise deducted, the record is the more interesting. In the past 13 years, $938,588 have been collected by the municipal water and light plants without any writeoffs for bad accounts. James Entwhistle is Commissioner of Streets and Public Improvements; Burkett Moliske is Superintendent of Water and Electric Utilities; and Edward G. Hand is City Clerk.

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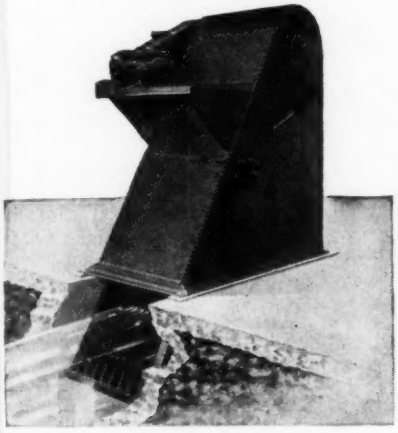
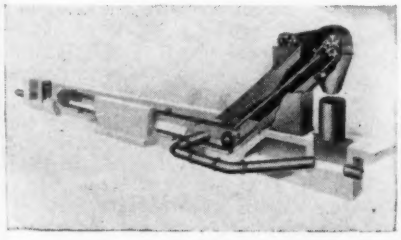
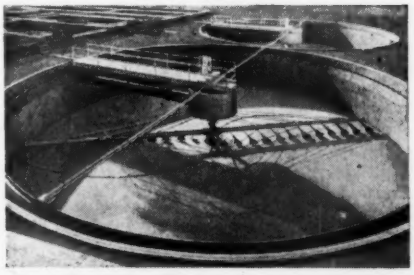


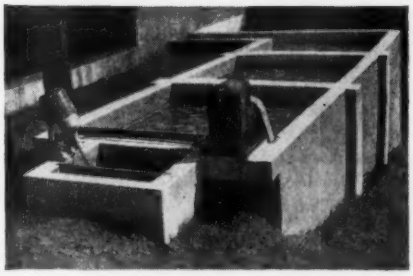
REX MECHANICALLY CLEANED BAR SCREENS are neat in appearance and provide an efficient means of removing large solids from liquids. They are easily installed in new or existing channels and have remarkably low head loss. With side frames recessed in channel walls, they assure an unobstructed flow to the rack.



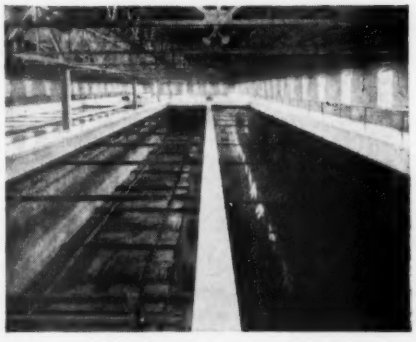
REX TOW-BRO SLUDGE REMOVERS are the only sludge collectors which remove sludge from tank bottom immediately on contact instead of by the usual blowing or scraping. They assure accurate control of sludge removal over a wide range of withdrawal rates. Greater sludge concentration, greater operating flexibility and a clearer effluent are all readily obtainable with Tow-Bro. ▶



REX FLASH MIXERS AND FLOCTROLS provide the necessary rapid dispersement of chemical throughout the liquid, followed by a gently multi-stage slow mixing for optimum floc formation. Floctrol designs assure utilization of full tank volume and important savings in chemicals. ▶



REX CONVEYOR SLUDGE COLLECTORS combine the well-known advantages of the rectangular settling tank with a rugged and efficient form of sludge removal mechanism. Whether handling primary sludge or light flocculent solids, their performance is trouble free and dependable. They rarely need to operate more than a few hours daily. ▶



REX GRIT EQUIPMENT, incorporating the exclusive principle of recirculation, effectively separates and removes inorganic solids from liquids. No grit washer is needed. Long life is assured ◀ with minimum maintenance.

REX SANITATION EQUIPMENT
Member of the Water and Sewage Works Manufacturers Association
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When you need special information—consult the classified **READERS' SERVICE DEPT.**, *pages 69-73*

An Outline for An On-the-Job Training Program for Water Department Personnel

Material on which to base instruction for water department personnel to insure better operation in more plants. Text references and instruction aids.

(Concluded from the July issue)

VI—Construction of Pipe Lines

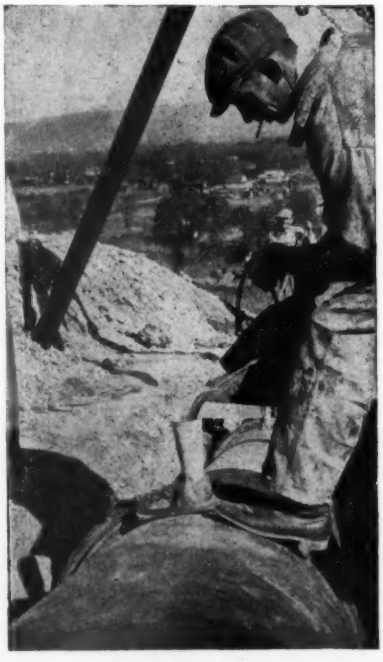
29. *General.*—Since a water pipe is intended to give many years of service and since it is placed underground where inspection is normally impossible and replacement is costly, initial construction should be the best possible. Water mains are usually located in streets or alleys; easements over private property are generally undesirable. To facilitate finding the pipe for repairs, tapping, etc., a specific location in the street or alley is desirable, which should be arranged by consultation with other users of the street subsurface. Lines should be "looped" as much as possible to avoid dead ends. Cover over the pipe should be sufficient to prevent damage from freezing or the weight or vibration of traffic. The two-main system is advantageous in reducing the necessity for cutting into street pavements. Before a water line is laid, a survey should be made, and plans and specifications for construction prepared in detail; this applies whether the work is to be done by contract or by force account. Also, the construction of the line should be under the supervision of an experienced engineer or inspector. His duties include everything that is necessary to insure a good job, including supervision handling the pipe properly, bedding, jointing, testing, backfilling and disinfection.

References. — Hardenbergh, par. 176-182 and 197-206. Texas Manual, Chap. XV. The Water Works Manual (for materials), Babbit & Doland, Chap. XVIII and p. 428.

Instruction Aids.—Show applicable pipe location map; a sketch of conduits, pipes, etc., under the average street surface; layout of two-main system; damages to a street from cutting into the pavement.

30. *Laying Pipe.*—Previous to laying the pipe, the trench must be dug and, in many or most cases, must be sheeted to prevent caving; excavated material must be kept well back from the edge. Pipe must be laid on a good foundation, extending over the entire length of each section of pipe. Rock or stones within 6 ins. of the pipe should be removed and the space filled with sand or loam. Holes should be dug for the bells. In soft soils, a support may be necessary for the pipe. Before laying, all pipe should be inspected to see that it is not cracked and that the protective coating is in good shape. Smaller pipe can be lowered into the trench with ropes; larger pipes are handled by cranes or hoists. Careful records should be kept of the location of all valves and hydrants. Back-fill should be of selected material for about 2 ft. over the pipe; and backfill should be well compacted, especially when the pipe is laid in streets. At sharp curves, large lines must be braced to prevent movement; air relief valves may be needed at major "humps."

References. — Hardenbergh, 176-200. Texas Manual, Chap. XV. Water Works Manual (for equipment). Babbitt & Doland, 428.



Pouring a joint with a single gate. Runner is vented on both sides of gate.

Instruction Aids.—Show methods of sheeting and outline safety rules for excavations. Show recommended methods of digging bell holes and of supporting the pipe. Enumerate duties of inspector on the job.

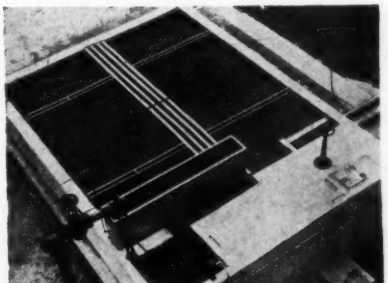
31. *Making Joints.*—This section refers only to making joints with bell-and-spigot cast iron pipe, using lead, mineralead, hydrotite or similar material. The spigot is centered in the bell and oakum is calked into the space around the spigot. Then the molten joint filler is poured into the joint, using a runner. The trench must be reasonably dry and the pipes, where the hot joint material touches them, must be perfectly dry. Careful workmanship is required to make a tight joint. Leakage should be carefully measured. Hydrotite, mineralead and similar materials may leak for a few hours, tightening thereafter. Leakage should not exceed 200 gals. per day per mile per inch diameter of the pipe, or 1600 gals. per day for a mile of 8-in. pipe. Good workmanship can reduce this leakage to less than half. Provision should be made on every job for measuring the leakage and pipe joints should not be covered until the test for leakage has been satisfactorily completed. Since the jute or oakum sometimes causes or encourages bacterial growth, it should be sterilized before use, either by heat or with a strong chlorine solution and a wetting agent. The pipe line also should be sterilized with a substantial chlorine dosage following acceptance for the leakage test and before use.

References. — Hardenbergh, par. 131-140. Texas Manual, Chap. XV. Water Works Manual (for materials). Babbitt & Doland, 318-321.

Instruction Aids.—Demonstrate the essentials of a good joint and how to make it. Show how to make a leakage test.

32. *Setting Valves and Hydrants.*—Hydrants should be placed on branches at least 6 ins. in diameter, with a gate valve between the main and the hydrant; and on mains large enough to deliver sufficient water to the hydrant. Drainage connections should not be made to a sewer. Gate valves, which should preferably be located uni-

. . . there could be such a *difference* in water!"



PERMUTIT (Spaulding) PRECIPITATOR removes water hardness, dirt and color by the sludge blanket process. This new-design equipment cuts detention time, saves chemicals, takes only half the space of former methods. Present installations handle up to 120,000,000 gallons daily.

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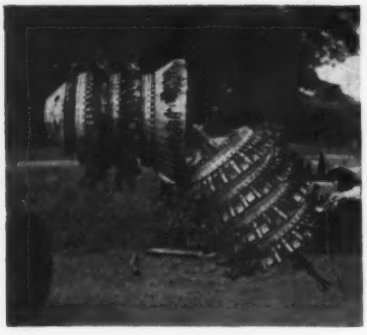


Equipment for pipe cleaning.

formly throughout the system, in relation to curbs, intersections, or other reference points, are placed in manholes or boxes. Records should be kept of the location, the way the valve opens, as right or left, and the number of turns required.

References. — Hardenbergh, par. 162-175. Texas Manual, Chap. XV. Water Works Manual (for materials). Babbitt & Doland.

33. *Disinfecting Mains and Reservoirs.* — Newly laid mains and other structures carrying water to be consumed should be disinfected before being put into service. Pipes are first flushed thoroughly and then a chlorine solution is introduced, using a strength sufficient to produce 50 to 100 ppm. of chlorine in the pipe line. After a contact period of 24 hours or more. the line is again flushed. Storage tanks are treated in essentially the same manner. Either liquid chlorine or a solution of calcium hypochlorite may be used. The efficiency of the sterilization procedure should be checked by bacteriological examinations.

References. — Hardenbergh, par. 189. Texas Manual, Chap. XV.

Instruction Aids.—Demonstrate and explain the procedure in properly flushing and sterilizing a main.

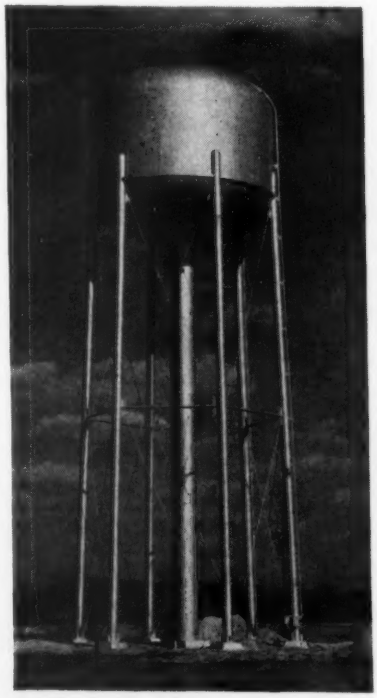
VII—Maintenance of Distribution Systems

34. *Pipe Line Maintenance.* — The AWWA has approved a method for the mapping of water distribution systems which, in effect, is an inventory of much of the physical assets of the water department. All changes made in pipes or appurtenances should be recorded and records should usually be kept in two locations. Unaccounted for water should be determined and should not exceed 20% to 25% of the total, and ought to be less. Meters should be tested for underregistration on a routine basis. as by years of service or amount of water registered. Leakage surveys should be made, either with department forces under a competent engineer or by a firm specializing in that work; and should cover both supply lines and the various portions of the distribution system. For departmental work, several leak-fiinding devices are available. Flow measurements may also be made to determine pipe interior conditions; and, of course. sections of pipe taken from the system during repairs should be examined and their condition recorded, thus over a period of years establishing what is happening to the pipes of the system.

References. — Texas Manual, Chap. XV. Water Works Manual (for equipment). Babbitt & Doland, 357-359, 389.

Instruction Aids. — Show AWWA standard mapping and recording procedures. Explain methods of testing for leaks and demonstrate leak-locating apparatus. Show sections of pipe taken from distribution systems, including corroded, encrusted and normal sections.

35. *Cleaning Water Mains.* — In those areas where deposits form on the interior of pipes, or growths occur, it may be economical to clean the mains. This will usually restore the capacity of the mains to about 95% of the original but will not, of course, prevent further growths or deposits in them. However, there are relatively few cases where recurrence of deposits or growth cannot be prevented by proper treatment of the water, using some of the methods described in Section II, or by lining the pipes in place. Restoration of practically the original carrying capacity may reduce or eliminate the need for extensions or additions.



Modern 200,000 gal. tank, 125' to bottom, Lansing, Mich.

References.—Hardenbergh, 205-206. Texas Manual, Chap. XV. Babbitt & Doland, 431-432. Water Works Manual (for equipment).

Instruction Aids.—Samples of partly clogged pipes. Devices used for cleaning. Explanation of how pipe is cleaned, with diagrams and charts.

36. *Electrolysis and Corrosion.*—Forms of corrosion occurring principally in water pipes are those due to (1) natural agencies, as aggressive water or damp soil in which the pipe is laid; (2) galvanic corrosion through contact of dissimilar materials; and (3) stray current electrolysis. Basically, corrosion is caused by the solution of the exposed metal by the water, the rate of solution being higher with low pH and alkalinity values. The greater parts of our existing distribution systems are inadequately protected against corrosive waters, and the methods described in Section II should be employed where corrosion occurs. When two metals having different solution pressures are in contact in water, as iron and brass or zinc and copper, an electric current is set up whereby one discharges metal ions into the solution and the other receives the ions. Prevention of such corrosion is obtained by avoiding the use of dissimilar metals or by providing a protective coating, or inserting an insulating layer between them. Current electrolysis results from grounding radios, telephones or other electrical equipment on water pipes, or from leakage of currents from street railways or power transmission lines, and is prevented by keeping the water lines free from such connections and by providing sufficient electrical drainage to keep other currents away from the pipes.

References. — Hardenbergh, par. 117, 128, 130, and 482-489. Texas Manual, Chap. XVII. Babbitt & Doland, 332-342.

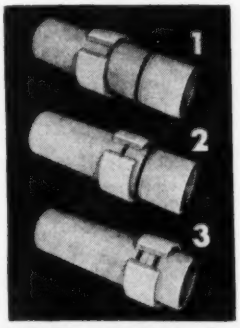
Instruction Aids.—Show samples of pipes affected by corrosion and by electrolysis and explain the action taking place in each circumstance, as well as the remedy available. Explain cathodic protection.

37. *Reservoirs and Elevated Storage.* Within the distribution system, elevated storage is required, usually in the form of elevated tanks or standpipes, generally of steel. Such storage, by smoothing out the peaks of demand, reduces the size of treatment plant necessary, of the pump capacity and of the piping; it also provides a more uniform water pressure; furnishes a reserve for fire protection; and may maintain service during periods of power or equipment failure. The water in such reservoirs, since it receives no further treatment before it is consumed, must be protected against contamination by tight covers and such other precautions as are needed locally. Frequent inspections should be made to detect leaks or determine the need for repairs. Good surface drainage should be maintained to protect the footings and foundations. Periodical cleaning of the

Engineering Facts about TRANSITE PRESSURE PIPE

Subject:—JOINTS

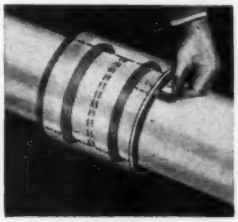
THE SIMPLEX COUPLING—the standard coupling for Transite* Pressure Pipe—was engineered by Johns-Manville to minimize costly underground leakage and to provide maximum protection against pipe line failures resulting from trouble at the joints.



SIMPLICITY of the Simplex Coupling helps assure perfect joints independent of workmen's skill. These cutaway views show complete assembly operation: (1) Start, (2) Sleeve pulled over one ring, and (3) Final position with sleeve centered over joint.

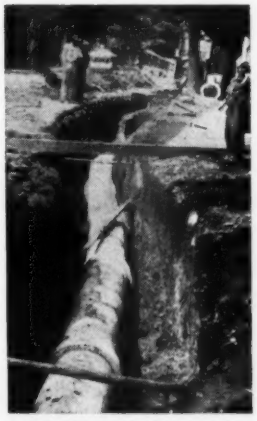
It consists of only three parts: a Transite sleeve, carefully machined to fit over the end of the pipe, and two rubber rings which, when assembled, are tightly compressed between pipe and sleeve. The result is a tight yet flexible seal that provides a number of important advantages.

First, its effectiveness does not depend on the individual skill of the workmen. The Simplex Coupling is, in effect, a factory-made joint which is simply *assembled* on the job. Perfect joints are quickly, easily made, even by inexperienced crews. And—a unique feature—each joint may be checked for proper assembly immediately upon completion.



PROPER ASSEMBLY of each joint is readily checked by inserting a feeler gauge between sleeve and pipe. If position of the rubber rings is correct, the joint is properly made.

Moreover, the flexibility inherent in the design of this coupling safeguards against leakage once the pipe has been placed in service. Because each joint is capable of deflection, the entire line has a flexibility not commonly found in other types of underground water line construction. This minimizes flexural stresses in the line . . . enables the pipe to conform to soil movement . . . helps it absorb the vibration of heavy traffic under busy city streets. Many thousands of miles of Transite Pipe confirm the ability of the Simplex Coupling to protect the line against the stresses that so often cause joint leakage and frequently result in pipe failure.



DEFLECTIONS up to 5° at each joint are possible with the Simplex Coupling. This permits laying the pipe around curves or obstructions as shown by the installation above.

Joints that stay tight in service are but one of many important advantages of Transite—the modern asbestos-cement pipe that was engineered to carry water more efficiently and more economically. For further engineering facts, write for Brochure TR-11A. Address Johns-Manville, Box 290, New York 16, N.Y.

The flexibility inherent in the Simplex Coupling helps guard against the shock and vibration of traffic. Under busy city streets, this factor also minimizes flexural stresses.

*Transite is a registered Johns-Manville Trade Mark

JOHNS-MANVILLE JM PRODUCTS

interiors is necessary, followed by painting. Cathodic protection may be employed to prevent corrosion. In northern areas, ice damage should be guarded against.

References. — Hardenbergh, par. 106-117. Texas Manual. Chap. XVI. Water Works Manual (for materials). Babbitt & Doland, Chap. XIX.

Instruction Aids. — Show typical hourly curves of water demand, including possible fire demand, to illustrate why storage is necessary. Show how storage may improve pressures at peak demand. Indicate types of areas where storage is needed, illustrating need by a suitable map.

VIII—Pumps and Pumping

38. *Kinds of Pumps.* — There are three general types of pumps — centrifugal, displacement and air-lift; and numerous subdivisions of these, including piston or plunger, rotary, centrifugal, turbine and screw. Pump capacity is usually expressed in gallons per minute. The head that pumps work against is an essential factor in their design, and includes the discharge head, or the water level against which the pump discharges (including pipe friction loss, etc.) and the suction head or lift, depending on whether there is a positive pressure or a negative pressure, or vacuum, on the pump suction. Most pumps operate most efficiently within relatively narrow limits of head and capacity; therefore careful estimates of flow and its variations, and of the high and low limits of head to be pumped against should be made. If the water contains abrasive materials, or is very acid or alkaline, this may affect the selection of the materials for the pump or the type of pump. Standby or extra pumps are usually necessary to carry the load in case of the failure of the regular equipment. Sizes of units should be so selected that regardless of the variation in demand of water, one or more of the pumps will be operated at practically full capacity at all times. Placing pumps in deep pits is undesirable, due to possible flooding and contamination, and to maintenance and operation difficulties.

References. — Hardenbergh, par. 242-269. Texas Manual, Chap. V. Water Works Manual (for pumping equipment). Babbitt & Doland, Chap. X.

Instruction Aids.—Show by simple diagrams the principles of each primary type of pump. Show how to compute discharge head. Illustrate need for several pumps of varying capacity to meet fluctuating demands for water.

39. *Centrifugal Pumps.* — These pumps operate by imparting velocity to the water through impellers rotating at high speed inside a case with rather large clearance. Single stage centrifugals may operate satisfactorily under heads up to about 300 ft. Above this, multi-stage pumps are used. Impellers may be open or closed, but the latter is generally used in pumping water. Operation is generally at about 1000 rpm. or more; usually the pump is direct-connected to an electric motor. Efficiency varies considerably at different speeds and head; impellers can be designed to give high efficiency over a narrow variation in head, or a reasonable efficiency over quite a considerable variation. However, major changes in head, speed or operating conditions should be cause for testing a centrifugal pump to determine its actual working efficiency.

References. — Hardenbergh, par. 251-257. Texas Manual, Chap. V. Water Works Manual (for pumps). Babbitt & Doland, Chap. XIII.

Instruction Aids.—Show sections of single and multi-stage centrifugals. Show and explain typical charts of performance curves.

40. *Displacement Pumps.*—The reciprocating pump, in which a piston or plunger is operated so as to draw water into a closed chamber and then expel it into the main, is a common type of displacement pump. The pump may be single acting, that is, it may pump water only during the time the piston moves in one direction; if it is so designed that it pumps when the piston moves in either direction, it is a double-acting pump. If another cylinder is added, it is a duplex; and if there are three cylinders, it is a triplex. The rotary pump is a special type of displacement pump that does not have any large application in water works. Plunger type displacement pumps for general service are best suited for high heads. They require rather skilled operation; under favorable conditions and for special problems, they may be highly satisfactory, but for most water works conditions they are less applicable than are centrifugals. For deep well pumping, plunger pumps have a special application.

References. — Hardenbergh, par. 244-250. Texas Manual, Chap. V. Water Works Manual (for pumps). Babbitt & Doland, Chaps. XI and XV.

Instruction Aids.—Show by diagrams or slides the principles of displacement pump operation.

41. *Power for Pumping.*—In most cases, electric power is cheap and reduces materially the amount of attendance and care necessary. With modern remote controls, individual pumps may be started or stopped without visiting the pumping station, and signals may be transmitted over telephone wires to indicate satisfactory operation or the lack of it. Standby power is necessary for any installation and this may be provided by gasoline, diesel, oil or gas engines. Diesel engines are highly efficient, but cost more initially than gasoline engines of similar quality and equal power; they are desirable as a power source when electricity is not available, or is too costly. Gasoline engines are generally used for standby power; and since when they are needed, the need for them is very great, they should be of excellent quality and high reliability.

References. — Hardenbergh, par. 262-269. Texas Manual, Chap. V. Water Works Manual (for engines). Babbitt & Doland, Chaps. XII and XIV.

Instruction Aids. — Discuss electric motors and remote controls. Show how standby power needs may be determined.

42. *Well Pumps.*—Deep well pumps may be of either the reciprocating type, which operates essentially like other displacement pumps, or of the turbine type, which is similar in operation to the centrifugal. The reciprocating deep well pump operates by means of rods, driven by an engine or motor at the surface, which are carried down into the well and operate the pistons by an up-and-down motion. The turbine type pump is operated by a drive shaft, which extends from the power unit to the impellers, which are below the water level in the well. The selection of the particular type of pump to be used depends largely on local conditions. Electric motors are the usual source of power; however, unless there is storage enough available to meet fire protection and consumer needs during a prolonged breakdown, standby power must also be provided.

References.—Water Works Manual (for equipment). Babbitt & Doland, Chap. XV.

Instruction Aids.—Explain with diagrams and slides, the principles and advantages of the various types of deep well pumps, their controls, etc. Show the film available from Layne & Bowler.

43. *Air Lift Pumps.*—These pumps operate by discharging compressed air into a column of water; and since the mixture of air and water is lighter in weight than the surrounding water, it is raised to the surface. The air lift has no moving parts in contact with the water and is therefore advantageous in handling water that contains sand or grit, or is corrosive. The compressed air is carried down inside the discharge pipe by a special air pipe, which reaches considerably below the surface of the water in the well. For lifts not over 150 ft., the air pipe should be submerged about 2/3, that is, the part under water is twice as long as that above water. For deeper wells, the submergence may be 40% to 50%. Air lift pumps have a rather low efficiency, and the depth of the well must be considerable in order to permit their use because of the required submergence of the air pipe. They are of especial value in crooked or spiral wells, where the water is 200 ft. or more below the surface.

References.—Hardenbergh, par. 258-260. Texas Manual, Chap. V. Water Works Manual (for equipment). Babbitt & Doland, 306-314.

Instruction Aids.—Show a diagram of an airlift pump and illustrate how

it works by means of a glass tube and blowpipe. Show volume of air required ($V = GPM \times head \div 125$).

A List of Other Recommended Texts

1. Analysis of Water and Sewage, Theroux, Eldridge and Mallman.
2. Laboratory Control of Water Purification, C. R. Cox.
3. Sanitation Manual for Ground Water Supplies, Public Health Reports, Vol. 59, No. 5, Feb. 4, 1944.
4. Water Conditioning Handbook, Permutit Co.
5. Copper Sulphate, Tennessee Corp.
6. pH and Chlorine Control, W. A. Taylor & Co., Inc.
7. Pump Engineering Data, Economy Pump Co.
8. Scientific Odor Control Booklet, Cargille Scientific Co.

Stream Pollution Standards for Washington State

The standards of the State Pollution Control Commission of Washington provide that no sewage or industrial waste shall be discharged into any waters of the state that will cause (a) the reduction of the dissolved oxygen content to less than 5 ppm.; (b) the pH concentration to be outside the range 6.5 to 8.5; (c) the liberation of dissolved gases, such as carbon dioxide or hydrogen sulphide, in sufficient quantities to be deleterious to fish or related forms; (d) the development of fungi or other growth having a deleterious effect on stream bottoms, fishes or related forms, or injurious to health, recreation or industry; (e) toxic conditions deleterious to fish or affecting the potability of drinking water; (f) the formation of organic or inorganic deposits injurious to fish, health, recreation or industry; (g) discoloration, turbidity, scum, oily sleek, or floating solids, or coat aquatic life with oily films or be injurious to health, recreation or industry; and (h) the temperature to be raised above the limit of tolerance of fishes and related forms.

In waters used, or reasonably suitable for use, as drinking water supplies, shellfish culture, or bathing; or in other instances where a definite public health hazard is created by the presence or potential presence of disease-producing organisms, the median bacteriological content of a representative number of samples shall not show the presence of coliform organisms in excess of 50 per 100 ml. expressed in terms of the most probable number, provided that the sanitary survey reveals that bacterial content is of human origin.

Inservice Training in Garbage and Refuse Collection and Disposal

The University of Michigan will hold an inservice training course on Oct. 27 and 28, for municipal officials engaged in refuse collection and disposal. Types of collection methods and frequency of collection will be discussed by Carl Schneider; equipment and labor saving methods, the organization of pick-up crews, the effect of labor-saving equipment and the employment of various methods of wage payments will be covered by Robert Neis, who had a long experience in this work in the army. Administration, including means of financing and methods of insuring cooperation and compliance, will be discussed by Carl Walker. Theodore Moss will develop disposal by hog feeding, bringing out both advantages and disadvantages, while Robert Stellwagon will discuss incineration, including site selection and operative problems. Walter Drury and George Wiley will interpret existing data on the disposal of garbage with sewage, and Lewis Dodson will describe land-fill methods. Ernest Boyce will close the course with a discussion of the various factors influencing the choice of disposal methods for both refuse and garbage. Full information can be obtained from H. E. Miller, School of Public Health, Ann Arbor, Michigan.

HOW TO INSPECT SEWERS AND DRAINS DURING CONSTRUCTION

THE following instructions for inspectors on sewer construction were prepared by Myron T. Jones, consulting engineer of Columbus, Ohio, and have been published by the Clay Sewer Pipe Assn., Columbus, O., from whom additional copies, in a handy form for field use, can be obtained without charge.

Keep a set of specifications for the job and a notebook with you at all times.

Make your own measurement to see that the cut from the batter-board corresponds with the cut sheets and markings on reference stakes.

Be sure that at least three batter-boards are in place at all times and at least 150 feet ahead of excavation and pipe laying. Check boards frequently to make sure that they have not been disturbed. Call the Engineer for reference stakes well in advance of the time you need them.

Make frequent checks of the grade cord to see that there is no sag and that it is straight for line and grade. Sight along the cord over at least three batter-boards and call the Engineer if the line is not straight.

Measure the grade pole and see that the proper pole is used for checking excavation and pipe setting.

Be present whenever a new stretch of excavation begins, when pipe is being placed in trench and when joints are made.

Make your check of trench depth and pipe setting by using the grade pole and plumb bob.

See that the trench is dug to proper grade to eliminate the need for replacing excavated material up to the level needed for properly embedding the pipe. The final few inches of trench excavations should be made manually. Study trench loading tables* to learn the advantages of keeping trenches narrow at least up to the level of the top of the pipe. Any increase in the width of the trench at this point adds considerably to the load on the top of the pipe. If trenches are wider than permitted by the specifications, notify the Engineer at once.

Before the pipe is placed see that there is a trough of firm material to receive the pipe. The trough should be formed so that the entire bottom quarter of the barrel of the pipe will be uniformly supported. Check locations of bell holes and have them dug separately by hand. If, by accident the trench is excavated too low, see that firm earth is placed in the trench. Earth should be placed in layers not more than six inches deep and each layer thoroughly tamped before the next layer is placed.

Check all pipe for soundness before lowering into trench.

Be sure that sockets and bells of pipe are clean and dry when joints are made. When setting pipe see that spigots are forced into sockets as far as possible.

Be sure that workmanship and material conform to specifications all the way around each joint and especially around the bottom quarter.

Check each piece of pipe for line and grade with grade pole and plumb bob immediately after its joint is completed.

As soon as the pipe is laid and joint completed see that the space under the haunch of the pipe is solidly packed with earth on both sides of the pipe to the springing line and that the joint is not disturbed during this operation. From the springing line up to a point not less than 18 inches above the top of the pipe, backfilling should be done by hand and tamped in 6-inch layers. Machine backfill may be made above this point only. Backfill under streets shall be made with sand or tamped in 6-inch layers to the top of the trench when immediate paving or repaving is contemplated.

All completed lines shall be lamped between manholes or in shorter stretches if desirable upon the completion of hand tamping and before machine backfill to see that it is straight for line and grade and free from obstructions. It shall be lamped again after completion of machine backfill and again before final acceptance.

Record the location of each branch fitting, noting if it points right or left looking upstream. Measure location of each fitting from center of nearest downstream manhole.

Record the size, kind, location and depth of each water, sewer, gas or other service pipe encountered during construction.

Be sure that sewer connections can slope at least 1% to branch fittings.

Make daily reports showing the location of beginning and ending of excavation, pipe laying and backfilling, total hours of Contractor's work, the number of men used in each operation, any unusual occurrence, the location of underground pipes and branch fittings, the kind of earth encountered in excavation and the exact times of your coming to and leaving the work.

Make a copy of your report in your notebook and keep in touch with the Engineer for special instructions.

*Ed. Note.—Trench Loading Tables are available from the Clay Sewer Pipe Association, Inc., Columbus, Ohio.

PUBLIC WORKS DIGESTS

Sewerage

Water Supply

Highways and Airports

This section digests and briefs the important articles appearing in the periodicals that reached this office prior to the 15th of the previous month. Appended are Bibliographies of the principal articles, in which the articles in each periodical are numbered consecutively throughout the year, beginning with our January issue.

The letter and number at the end of each item refer to those used in the Bibliography. Numbers not found in the current Bibliography will be found in the one published the previous month.

The Highway and Airport Digest

Maine's 44-Mile Superhighway a Toll Road

A 44-mile controlled-access superhighway, part of an authorized toll road from the southern boundary of Maine to its northern boundary, a distance of 450 miles, which will cost $20,000,000, incorporates all the latest standards considered essential for such a road. The highway has two 24 ft. two-lane roads separated by a 26 ft. median strip. The maximum grade is 4%; maximum curvature 1°; minimum sight distance 525 ft. The right-of-way is 300 ft., but only 140 ft. is being cleared, leaving 80 ft. of trees and shrubs on each side to discourage billboards and enhance the natural appearance of the roadside.

Major emphasis has been placed on preparation of a frost-free subgrade. Grades are generally established several feet above natural ground to facilitate drainage and snow removal. Wherever the subgrade soil is unsatisfactory it is removed and replaced with from 1 to 4 ft. of A-3 select material from borrow pits rolled to maximum density, such material having less than 10% passing a No. 200 sieve. The average haul of this material has been 1.53 mi., while that of other borrow is 0.7 mi.

The maximum depth of cut was 27 ft., and 96% of the excavated material was used for fill. Embankments were rolled in layers 4" to 9" thick, using dual-drum sheepsfoot rollers, rubber-tired rollers and tractors, and 10- and 12-ton three-wheel rollers. If the material did not compact by rolling, it was thoroughly saturated. If the sand lacked fines and would not compact by saturation, 2" to 4" of gravel was spread over the surface and rolled. Elevations on last year's embankments were taken during the winter and showed absence of heaving from frost action, although there was considerable in the natural ground adjacent.

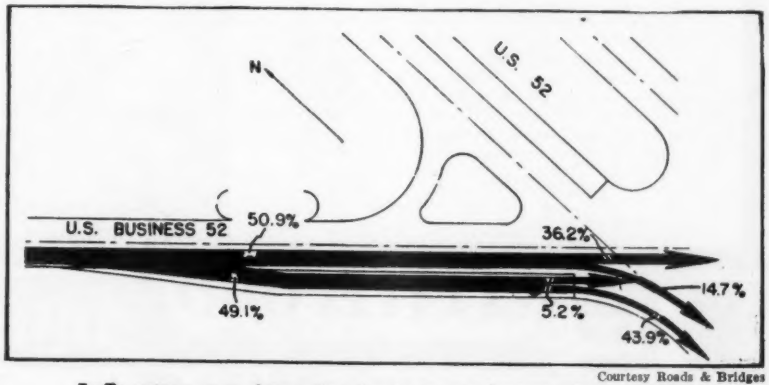
The pavement is a 2" asphaltic wearing surface on 5" to 6" of hot-mix machine-spread asphaltic concrete. Shoulders are a compacted gravel base, the surface of which is treated with asphalt into which a thin layer of aggregate is rolled.[L11]

Surface Dressing With ¾" Aggregate

This article is based on experience in England. There ½" stone is found most suitable for surface dressing, but in some cases nothing smaller than ¾" is obtainable. Use of this size is inadvisable on concrete, rock asphalt or other hard surfaces, or on light traffic roads unless more than the usual amount of binder is used to hold it in place until the traffic embeds it into the old surface. A disintegration failure will produce a more irregular surface when ¾" stone has been used than with smaller sizes. Dressings with ¾" stone cast about 25% more than those with ½", chiefly because more material is required. The amount of tar binder used for ¾" rock averages about a gallon for each 4 to 5½ sq. yd., or even more on light traffic or hard surface roads. The amount of stone is usually 70 to 80 sq. yd. of road per ton. Traffic should not be allowed on the dressing until the stone is adhering to the binder, about ½ hr. under favorable conditions.[D21]

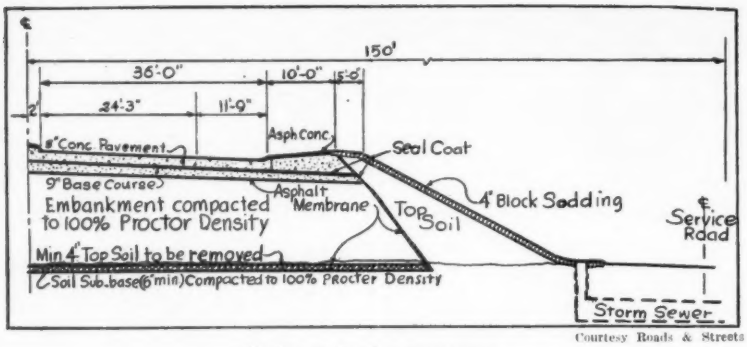
Use of Sleeper Lanes

Studies of the traffic flow at several intersections of highways in Indiana showed, among other data, that "sleeper lanes" were not being used as intended. A relatively high percentage of those entering the sleeper lanes did not turn but continued straight across the intersection. Also an appreciable number who made right turns did not use the sleeper lane. Each misuse causes a definite traffic hazard. Most of those who do use the sleeper lane for right turns do not utilize the full length of it. The design features appear to be adequate but some educational or signing program is needed.[O34]



Courtesy Roads & Bridges

Traffic pattern at an intersection showing use and misuse of sleeper lane.



Courtesy Roads & Streets

Section of Houston expressway.

Design for Houston Expressways

In the construction of the Houston Urban Expressways now under way, all top soil is removed to a depth of at least 4" and the natural soil compacted to 100% Proctor density to a depth of 6". The embankment, if any, is placed on this and compacted to 100% Proctor and completely enclosed in an asphalt membrane to minimize fluctuation of moisture content and consequent loss of stability. The embankment slopes are then covered with a minimum of 4 ft. of top soil compacted to 80% to 90% Proctor; plenty of soil being available and it being essential that no vegetable roots penetrate the asphalt membrane. As soon as practicable all slopes steeper than 6:1 are block sodded. A standard flexible base course 9" thick extends 1 ft. outside the concrete pavement which is laid on it, and is covered with an asphalt seal coat under the concrete. The pavement slabs are 20 ft. long, with longitudinal parting joints 12 ft. apart. Transverse joints are filled with dense elastic wood, which is expected to compress 50% and expand again to 85% of its initial thickness.[N63]

Los Angeles Asphalt Plant

Los Angeles has nearly 5,000 miles of streets to maintain, and for the purpose operates three asphalt plants, one of which has just been completed at a cost of $325,000. It is designed to turn out 447 4,000-lb. batches a day of almost any type mix. Besides the batching facilities there are garage space for 20 10-ton trucks, a shop, living quarters for a caretaker, switch house, compressor house and scale. Except for flame-drying of aggregates, all heating is done electrically. Bunkers store 1,000 tons of materials, which are fed onto a belt 24" wide by 304 ft. long traveling in a 7 x 8 ft. tunnel 11 ft. underground immediately below them. The belt delivers the materials to a pit, from which they are raised 39 ft. by an elevator which can deliver 150 tons per hr. to the dryer. The fire-box, of an unusual conical shape, contains a Bunsen-type burner with T nozzles for natural gas, which can dry and heat to 325°F 150 tons an hour of material having a 10% moisture content. The asphalt weigh bucket and its valve are heated electrically to permit the asphalt to flow freely. Dust control is insured by use of a cyclone and a multiclone in conjunction with a spray chamber.[J10]

Reducing Construction Costs in Missouri

Finding bids for post-war secondary roads almost double pre-war bids, and that much of this was due to high wages and low efficiency of labor, the Missouri State Highway Dept. has changed its specifications with a view to lowering costs. Instead of requiring construction to be "true to line and grade," it now permits maximum tolerances of 6" in grade and 2 ft. in

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alignment, eliminating much hand work for finishing. In clearing and grubbing, stumps can be cut flush with the surface where the fill is 1 ft. or more deep, instead of the former requirement of 1 ft. below the surface where the fill is less than 2 ft. Earth embankments can be placed in 12" lifts instead of 6". Scarification and removal of rocks is required to a depth of 6" instead of 12". Rubbing of concrete structures is no longer required except for patches on honeycombing. In constructing I-beam bridges, machine bolts can be used in place of rivets. Density requirement in backfill is reduced from 95% of standard to 90%. Crossroad culverts on roads carrying less than 400 vehicles a day can now be made with pipes up to 84" diameter without headwalls, thus eliminating many reinforced concrete box culverts.[R26]

Soil Compaction And Subgrade Strength

Experimental work on soil compaction conducted in the laboratory of the Engineering Experiment Station, University of Utah, has shown that:

1. Existing methods of compaction control, such as AASHO T-99-38, California bearing ratio test, etc., although correct within the range employed, do not exhaust the density-bearing power possibilities for a given soil.

2. For a given soil, conditions of ultimate density (with correspondingly higher stability and bearing power) can be obtained, provided that the soil is compacted not only at an optimum moisture content, but also at an optimum compactive effort.

3. If the soil is compacted under conditions that provide this ultimate density, bearing power in the magnitude of six or seven times that which would normally be obtained will result. If adequate waterproofing methods (drainage, surface sealing, etc.) are followed, this greater bearing power can be used for design purposes.[L10]

Traffic Striping In California

California Division of Highways early in 1946 adopted a combination solid and dashed 4" white traffic stripe for certain conditions, the painted lengths being 9 ft. long spaced 15 ft. apart. These provide good visibility under varying conditions and effect a 60% reduction in cost of material. Paint manufacturers have developed paints which are satisfactory as to quick drying and long life under the wear of traffic, good adherence to concrete and to a variety of bituminous surface types without serious discoloration, and also serve to hold glass beads embedded in them. In order to place these stripes, the division has developed a machine which turns the paint on and off at definite intervals, matching the original marking, and also synchronizes the operation of the bead dispenser. One such machine is in use and 11 others were under construction last spring, when this article was written. The machine can, without stopping for adjustment, place a single broken stripe, or a solid stripe with a broken one on either the right or the left of it, or double solid white stripes, or a continuous black stripe between double stripes. It dispenses beads at a predetermined rate; can paint an offset stripe where the machine itself cannot be operated. Operations are controlled by 4 levers, 2 of which control the supply of air and paint to the spray guns and bead dispensers, the other two operate the spray gun atomizers. The air and paint are carried in pipe lines from the supply truck to manifolds installed close to the paint spray guns.[W4]

Sprays for Killing Weeds

Spraying or powdering roadside weeds with 2, 4-D will control a great variety of broad-leaved weeds and shrubs, is non-poisonous to livestock, is relatively cheap and easily applied. It kills the top of the weed and so prevents storage of reserve food in the roots. At least 11 compounds are on the market varying from 10% to more than 80% 2, 4-D content. The dose is generally 1 to 3 lb. of active material per acre, usually applied as a solution. Recently nozzles have been used that

When you need special information—consult the classified READERS' SERVICE DEPT., *pages 69-73*

apply accurately as little as 2 gal. of oil or 5 gal. of water per acre, so that a 100-gal. tank will hold enough liquid to treat 10 to 20 acres. High pressure sprays are not desirable. As use of this chemical by highway departments is quite recent, the best method of adapting its use to its own special climate and weeds will have to be learned by each department for itself.[R27]

Joint Sealing In California

Experiments are under way by the California Div. of Highways to find the best material for filling pavement joints. These have led to the use of a mixture of 70% 31-40 air-blown asphalt and 30% SC6 liquid asphalt; modified to a 60-40% mix where the other is too brittle. Experiments are continuing, including a rubber latex compound, which is very expensive both to purchase and apply, but may be used on the more important routes. The aim is to find the best and most economical material which will be reasonably ductile within normal temperature ranges, which will remain adhesive to the walls of the joint, and will neither become so brittle as to chip out in cold weather nor so soft as to extrude in hot weather.

A substitute for hand pouring with cornucopias developed by the department consists of a ⅜" nozzle connected to the rear of a heating tank or a 400-gal. asphalt kettle by pipes with swivel joints, through which the asphalt is circulated at a temperature of 350° to 400°. The nozzle discharges two streams, the one ahead and smaller being to drive the air out of the joint. Two longitudinal joints can be poured at a time at a speed of 1.5 to 1.8 mph. No satisfactory substitute has been found for hand pouring of transverse joints and cracks. Costs in two districts for filling longitudinal joints averaged $14.30 per joint-mile by hand and $8.25 by the special equipment.[N60]

Extension of Kanawha Boulevard

In 1946 the West Virginia State Road Commission built a 1.5 mile extension to the divided dual-lane boulevard leading east from Charleston. It consists of two 22 ft. roadways separated by a 4 ft. median strip with mountable curbs and a 3 ft. grass plot, and shoulders 7 ft. 6 in. wide on fills and 6 ft. in cuts. The pavement is 8" concrete reinforced with a layer of mesh reinforcement placed 2" below the top. Doweled expansion joints are placed at 93 ft. intervals and contraction joints 31 ft. apart. A 4" layer of gravel of maximum 2" size was placed placed directly beneath the pavement. Air-entraining cement was used to prevent abrasives containing salt from scaling of the surface, and it also improves workability; the average air entrainment being 4.8%. The mechanical spreader placed 6" of concrete, on which the reinforcing mat was laid, then spread the additional 2", which was at once finished with a mechanical finisher, floated by hand, and covered with a curing membrane compound.[E41]

Salting Streets In Syracuse, N. Y.

Syracuse has 240 miles of paved streets and 154 miles of dirt ones. After a snowfall all of these are plowed and 50 to 60 miles are salted. Salt is applied before the snow has been packed, beginning between 3 and 4 o'clock in the morning in the business section. Sand formerly was used on steep grades but it tended to blow off before it became embedded and had to be cleaned out of catchbasins in the spring, and its use has been discontinued. Also salt melts up to 4" of snow, reducing the amount that has to be handled. In distributing salt the city uses its trucks and 6 mechanical rock salt spreaders. It uses 32 plows, hiring private trucks as needed.[P25]

Widening an Ohio Road

In widening 14 miles of U. S. Route 40 east from Springfield, O., by placing 2 ft. of bituminous concrete on each side, contractor Max J. Zellar organized the operation to move continuously along one side by means of

equipment that extended for about a mile. First a motor grader loosened the soil; then a trenching machine excavated the trench 9" below grade; a trench roller compacted the subgrade; a 1¼" insulation course of screenings was placed with a spreader box and a water wagon moistened it and a trench roller compacted it. Following these six pieces of equipment, two men with brooms cleaned the edge of the old pavement, which was then sealed with asphalt by a small distributor, and two 3" hot-mix base courses were spread and compacted by trench rollers, the second as soon as the first had cooled, and a ¾" hot-mix leveling course was placed. Finally the edge of the pavement was painted and the 1" hot-mix surface course was placed and rolled.[N62]

Runways at March Field

After reviewing briefly the development of runway construction at March Field, Calif., since 1937, the author describes the construction of the latest, for a gross load of 120,000 lb., 7,000 ft. long by 150 ft. wide, with 75 ft. paved shoulders and 100 ft. on each side of granular fill penetrated with asphalt. For the sub-base, 18" of imported granular fill with a minimum CBR value of 40% was compacted in 6" layers with sheepsfoot rollers and smooth rollers. On this was placed 6" of dry-bound macadam compacted in two layers with 10-ton smooth rollers; followed by 4" of crushed rock aggregate, open-mix, asphaltic concrete. The finished pavement was tested by running a 150,000 lb. roller back and forth 100 times on the same track a distance of about 100 ft., which gave a maximum vertical displacement of 0.2 in. Also 75 ft. taxiways were constructed of 18-11-18 concrete slabs on a 12" compacted granular materal base. They are now preparing designs for airplane loads of 300,000 lb.[E37]

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Variable weight roller at work on an Illinois road. Courtesy Galion Iron Works & Mfg. Co.

The Waterworks Digest

Unaccounted-for Water in Minnesota

A questionnaire answered by 31 Minnesota water departments concerning unaccounted-for water showed plainly that measurements and estimates of water quantities by many departments were inaccurate and inconsistent. Three departments reported more water accounted for than they drew from the source. Two reported more than 44% unaccounted for. Omitting the 7 highest and 7 lowest figures as being questionable, the average was 11.4%. Using this average, and assuming the average cost of water at 10 ct. per 1,000 gal., it is estimated that the unaccounted-for water in the state costs $1,000,000 a year, of which $122,000 is leakage. (Other surveys make the leakage figure $800,000.)[A79]

Postwar Consumption

The American Water Works and Electric Co. has 70 subsidiary water companies located in 19 different states, which are believed to afford a good cross-section of the water works industry in the eastern half of the United States. In 1940 these companies distributed 97,597 mg, and in 1946, 127,360 mg, an increase of about 30%. A decrease after the war had been expected rather than an increase, and the subject was investigated. It was found that during these 6 years the active residential customers had increased 12.4% in number, 26.2% in total consumption, and 12.4% in consumption per customer. Commercial customers increased 8.9% in number, 35.4% in consumption, and 24.6% in consumption per consumer. Industrial consumers changed little in number but their consumption increased 41%.

The suggested explanation for residential consumption is that the number of people per connection was increased by the return of war veterans to their families and the 100% occupancy of apartments; also more and better plumbing is being installed in the new residences. The increase in industrial consumption may be due partly to change in the character of products manufactured and also that plants not completed until the end of the war have been bought from the government and put into service.[F62]

Results With Chlorine Dioxide

Experiments in the use of chlorine dioxide started in 1944 at Niagara Falls purification plants, the chlorine dioxide being generated by delivering water containing at least 500 ppm chlorine at pH 3.5 or lower to a reaction chamber, where sodium chlorite solution is added. Following this, the treatment was adopted at a number of plants, experiences at which lead to the following conclusions:

1. Contaminations caused by phenols, along with algae, oil wastes and other taste-producing compounds, have been controlled successfully.

2. A method has been provided whereby severely fluctuating conditions can be handled with ease.

3. A method of taste and odor control has been provided which is economical and does not require careful chemical control.

4. The maintenance of free chlorine residuals throughout the distribution system, without objectionable odors, has been aided.

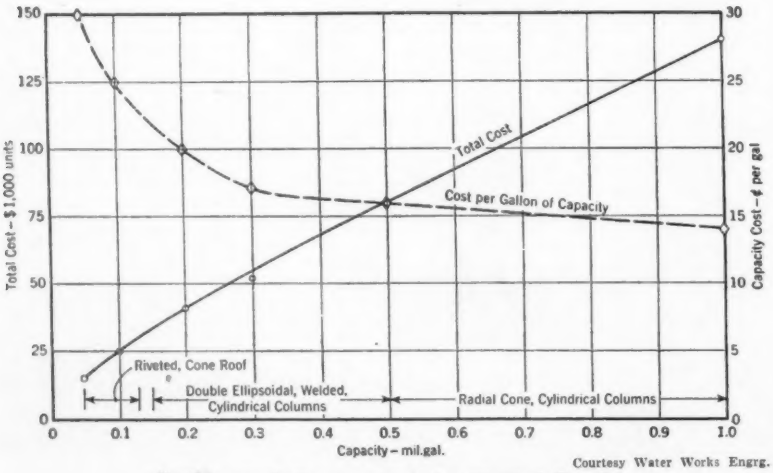
Chlorine dioxide has been used in solving many types of water works problems. It is not a cure-all in itself for all taste and odor problems, but the results indicate that it is a valuable tool for attacking many water treatment problems.[A96]

Designing Elevated Tanks

Pleasing appearance of an elevated tank is desirable, and companies are continually offering new designs with this in mind. Welding permits greater variation in design details than was possible with riveting. Another aim is to provide minimum depth of tank for a given capacity. Tubular columns are preferred to structural ones because of appearance, elimination of cross-bracing for heights up to 100 ft., and lower maintenance cost. The newest development for large-capacity tanks is the spheroid with two sets of supports, an outer circular girder supported by columns, and an inner support either similar to this or a center cylinder. Use of fluted sections for the cylinder makes it capable of withstanding a much heavier load and gives a pleasing appearance. For small tanks, waterspheres are built up to 200,000 gal. capacity on towers up to 125 ft. high, costing more than if supported by columns. A variation is the "milk stool," supported by inclined columns meeting just under the tank. Double ellipsoidal tanks with tubular bottoms are made in capacities down to 50,000 gal., supported by 4 to 8 columns. For painting, a "self-chalking tank white," which cleans itself as rains wash off the chalked pigments and lasts 3 to 7 years, gives a clean appearance and keeps the water cooler than any other paint.[A91]

Planning Elevated Tanks

The functions of the elevated tank are to supply that part of the peak rates of demand which is above the day's average rate of pumpage; permit operating the pumps continuously at more nearly their rated head and capacity, thus minimizing demand charge and cost of energy; insure uninterrupted service during possible interruption of power; increase the efficiency of the distribution system.



Courtesy Water Works Engrg.

Monthly record of water output, Am. W. W. & Elec. Co.

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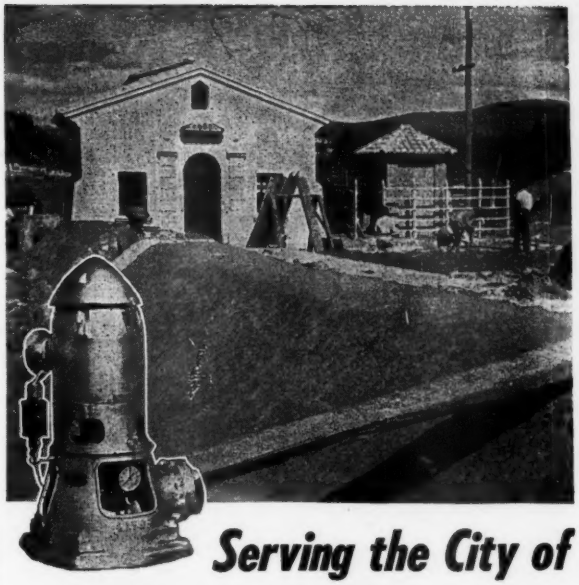

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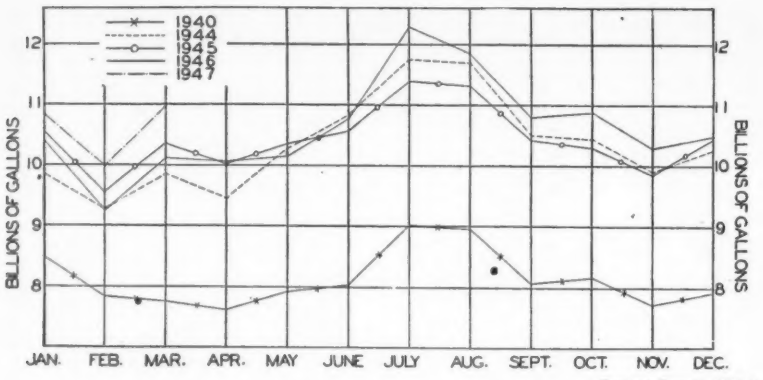

Courtesy Journal AWWA

Approximate cost of elevated tanks with 100-ft. towers.

thereby improving pressures; and provide some reserve for fire protection. They serve best when located at the side of the distribution system opposite to the pumping station; this permitting smaller mains and insuring less variation in water pressure in the distribution system.

To determine the amount of storage desirable, determine the hourly pumpage rates on the day of maximum domestic consumption. Comparison of the maximum hourly rate with the average rate for the day gives the storage needed to permit uniform rate of pumpage throughout the 24 hours. In one case cited, storage equivalent to 5% of the maximum day pumpage reduced the peak pumpage rate from 131% to 114% of the 24-hour average; 10% storage reduced it to 106%; and 15% storage permitted practically uniform pumpage throughout the maximum day. If the storage is provided to iron out the peak rates, it is sometimes desirable to valve off the tank for part of the day, reserving storage for the maximum peak hours.

The cost of tanks per gallon capacity increases rapidly as the capacity decreases from 300,000 gal., and for sizes above 500,000 gal. the cost per gallon remains almost uniform; therefore two 500,000 gal. tanks cost little more than one 1,000,000 gal. tank, and may provide better service by placing them at different suitable locations.

Up to a certain height (approximately 75 ft.) a standpipe can be built for the same or less cost than a 1 mg elevated tank of the same diameter and overflow height. Although the storage below what would be the bottom of the elevated tank is not useful for meeting the daily fluctuations of demand, it provides a relatively large volume of additional storage for emergencies such as a broken main or large fire. This storage can be further utilized by providing a booster pump to deliver it to the distribution system.[A90]

Removal of Iron and Manganese

The subject of iron and manganese removal by free residual chlorination has been studied by jar tests, followed by a 10 gpm experimental plant at Sioux Falls, by the South Dakota State Board of Health, from which the following conclusions were reached:

1. Iron and manganese removal can be effected by free residual chlorination at normal pH values and without elaborate treatment facilities.

2. The free ammonia content of the water prevents the oxidation of manganese by chlorine until it is neutralized by the free chlorine residual.

3. Ordinary iron-removal equipment,

providing aeration, sedimentation and filtration, plus free residual chlorination, can also be used to remove manganese. Where the amount of manganese is large, the addition of a high-rate contact filter will aid greatly in eliminating the colloidal character of the precipitate and thereby lengthen filter runs.

4. Sedimentation removes very little manganese but does aid in preparing the colloidal precipitate for filtration.

5. The oxidation of manganese by chlorine is a slow reaction when carried out in a settling basin, but proceeds very rapidly when water is filtered through an ordinary rapid sand filter. Furthermore, the filter sand does not need to be coated with oxides of manganese from long previous usage.

6. The chlorine dosage is easily controlled after the proper residual value for the finished water has once been established.[A95]

Pressure Control By Zone Distribution

Within the area of the city of San Francisco land elevations vary from zero to four peaks of more than 900 ft. Controlling water pressures in the distribution system is complicated by the existence of 22 isolated areas with elevations ranging from 200 to 800 ft. The city is divided into 9 pressure zones, but 87% of the water used is supplied to the three lowest. A pressure of 60 lb. is considered ideal, but minimums at the upper limits of the zones run as low as 40 psi and maximums at the lower limits up to 80 or 90, with an exceptional 140. The lowest zone is fed from two reservoirs with elevations of 172 ft. and 187 ft. respectively. The next zone from a reservoir at 255 ft., and the third from one at 385 ft. The next is at 614 ft., giving a jump in pressure of about 100 psi from the 2nd to the 3rd zone, or a pressure of 130 lb. The next reservoir is at 800 ft., which supplies about 1,000 acres only. The isolated areas are petty nuisances and about every known method is used for supplying them. The two largest are supplied by piping water from the third zone and cutting down the pressure 160 ft. by means of pressure-reducing valves, which have been operating for 18 yr. without the least trouble. Six of the high areas are supplied by pressure pumps automatically operated.[F52]

Labor Saving by Louisville, Ky., Waterworks

In 1945 Louisville's municipally-owned water company, because of the scarcity of labor, began the intensive use of mechanism in laying main extensions and services. A ditch is dug by a Barber-Greene ditcher and the pipes, valves and fittings are lowered into it by a small truck-mounted crane and backfilled with a bulldozer. Services are jacked into place with a "Hy-

drauger" or pipe pusher; or a ditch 6″ wide and 5 ft. deep is dug by a small ditching machine mounted on the rear end of a "jeep." To install meter boxes, holes are bored with a truck mounted 24″ post-hole digger. For making cuts in pavements, a truck carries an air compressor and all the necessary tools. A mobile crane handles the pipe and fittings in the yard.[J13]

Chicago's New Filters

Chicago's South District filtration plant, started in 1938, was 90% completed by July 1947, 60 of the 80 filters being in operation in June and each of the remaining 20 being put into service as soon as completed. Recent delay has been due partly to strikes in the pump manufacturer's plant, because of which two 40-yr. old pumps were removed from the scrap pile and reconditioned for pumping wash water.

The plant comprises a low-lift pumping station, 3 chemical mixing basins, 3 settling basins, 80 filters, 2 filtered-water reservoirs, a chemical building, laboratory, administration building, shops and garage. The raw water is pumped to the mixing and settling basins, each of which is divided into an upper and lower section, and from these goes to the filters. Each settling basin is 138 by 500 ft., giving a retention period of 3.5 hr. Sludge removed from both upper and lower basins by drag scrapers and flushing goes to a common sludge channel. Sludge will be removed continuously by scrapers, and at intervals each basin will be dewatered and flushed by hose; all sediment being discharged into the lake 3,000 ft. from shore. Dry chemicals will be unloaded pneumatically to horizontal screw conveyors which distribute it to 31 storage bins.

The filter underdrains are 4″ c. i. pipes spaced 12″ apart, perforated with 7/16″ holes spaced 6″ apart and facing downward. Each filter has a surface wash of the fixed jet type; a 12″ header along the side wall has 18 3″ laterals with 1″ down-pipes to jets located 3.45 ft. apart along the pipes, each jet having 5 holes, 4 projecting the water 30° from the horizontal and the 5th straight down. Each filter contains 9 flat, level washwater troughs.[F63]

Elevated Storage

In planning storage on a distribution system the following general principles should be guides:

1—Storage should be reasonably close to heavy peak drafts of water and on the opposite side of such points from the pumping station.

2—Elevated storage at the pumps helps the pumps but does not add to the capacity of the distribution system, which involves more than half the cost of the average water works.

3—Elevated storage on the opposite side of heavy draft permits water to be fed from both ends of the distribution system, thus nearly or quite doubling the capacity of the feeders.

4—The top of the stored water will necessarily be slightly below the maximum existing pressure plane of the pumps; but must *not* be too high to fill in the night hours of a peak day. The depth should be as shallow as reasonably possible; 20 to 25 feet is common.

5—The value of storage is largely lost when too far away. Costly pipes can overbalance the advantage of storage.

In flat country, the elevated tank is used, preferably in shallow depths. Where an elevated site is available but not high enough for a concrete reservoir on the ground, circular steel tanks up to 40 to 60 ft. high and of large capacity can be built for less than half the cost of elevated tanks per unit of capacity. Where the ground is high enough for a buried reservoir, these cost about half as much as elevated tanks. In some cases a reservoir or tank may be filled at night by bleeding from the mains, and this stored water be repumped into the mains as needed.[G31]

Slow Sand Filters For London's Water

The chief engineer of the Metropolitan Water Board, which supplies the water for London, England, has recommended the addition of a filtration plant with a capacity of 55 mgd. Water from one of the existing reservoirs would be aerated by cascading, then passed through "micro-screens" and from these to 32 slow sand beds, each about ¾ acre in area.

Decision to use the screens resulted from experiments made during the war by passing stored water through a rotating screen which had such a fine mesh that it was able to entrap the algae and other larger impurities in the water, and thus perform the same function as a primary filter. The results obtained from the use of this screen in conjunction with a slow sand filter show that the screen is able to reduce the algal content of the water to much the same extent as a primary filter.

From the aeration basins, therefore, the water would pass through a battery of micro screens instead of to the conventional primary filters. The cost of installing such screens would be less than the cost of primary filtration plant of equal capacity, there would be a smaller loss of head, the concrete work would be simpler, and the installation would be more rapid.[Y9]

Water Supply Needs of the United States

The U. S. Public Health Service estimates that more than 2 million persons living in communities of over 200 population have no community water supply systems, and the systems supplying 79 million need improvements. Fewer than 11 million live in communi-

ties for which no water supply improvements are scheduled. In rural areas more than 27 million need new or improved water supplies. To remedy these conditions would take $2,200,000,000 (based on prices of June 1946), about a third of this for development of water supply sources. This includes 5,700 complete water works systems, most of them for towns of less than 1,000 population, and improvements in the systems of 14,800 other communities. About 3200 new treatment plants are needed and improvements to 4,700 existing plants. More than 45,000 miles of mains are needed.[L2]

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The Sewerage Digest

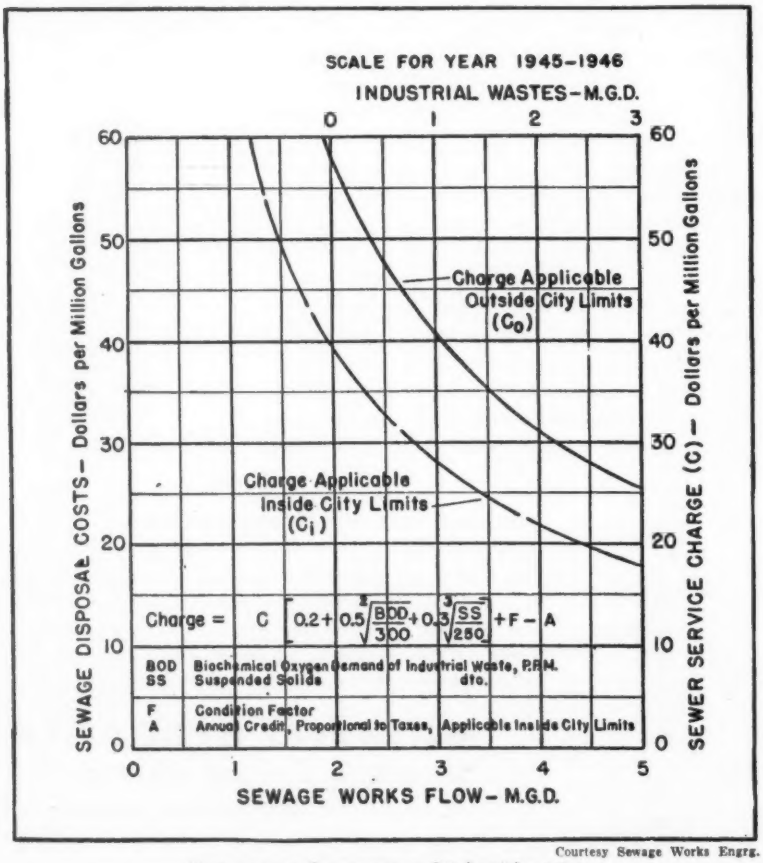
Charges for Treating Industrial Wastes

Salinas, Calif., treats in a 2-stage biofilter the sewage from a population of 15,000 and also the wastes from dehydrating, quick-freezing and canning an enormous amount of vegetables; the latter being pre-treated in a roughing biofilter which reduces the B.O.D. about 50%.

The city charges the industries for handling their wastes. Operating costs plus capital charges are apportioned 20% for pumping, 50% for treatment and 30% for sludge handling. Treatment costs vary directly as the B.O.D. concentration. Sludge handling costs vary directly as the suspended solids concentration. The treatment and sludge handling costs are calculated as a square root and cube root function of the ratios of the B.O.D. and S.S. concentrations of the industrial wastes to the corresponding normal values for domestic sewage (300 ppm and 250 ppm respectively.) The calculation of charges is made by the formula given on the diagram. A condition factor "F" is to compensate for any added expense due to decomposition of the wastes on the way to the treatment plant, necessitating special odor control or other auxiliary treatment.[H35]

Embedded Coils in Digesters

Designs for digestion tanks for Puyallup, Wash., include the embedding of heating coils in the walls, instead of suspending them inside. The chief reason was to reduce maintenance cost—exposed heating coils are subject to sludge caking and it is difficult to maintain their efficiency. Six rings of ¾" copper tubing spaced 7" apart, with the bottom one 20" above the bottom of the tank, are set 2" from the face of the concrete. The tanks are 40 ft. diameter, with wall 21 ft. high. The heating system is designed for a sludge temperature of 85° and maximum temperature of the concrete surface 140°. The sludge temperature will be maintained by thermostatic control, by means of a bulb thermometer suspended in the middle of the tank, which controls the pumps that circulate hot water through the coils. It is thought that the greater portion of heat transfer to the sludge will be by conduction and convection. Radiation would effect a better penetration of the sludge and more uniform heat distribution, and may be found to take place. This method of heating has been criticized because "the added resistance of the concrete would inhibit the flow of heat"; but the temperature of the surface of the concrete will be as high as should be permitted for exposed pipes, and will have more contact area.[E10]



Courtesy Sewage Works Engrg.

Costs per mg. for sewage and industrial wastes.

Mechanical Sewer Cleaners

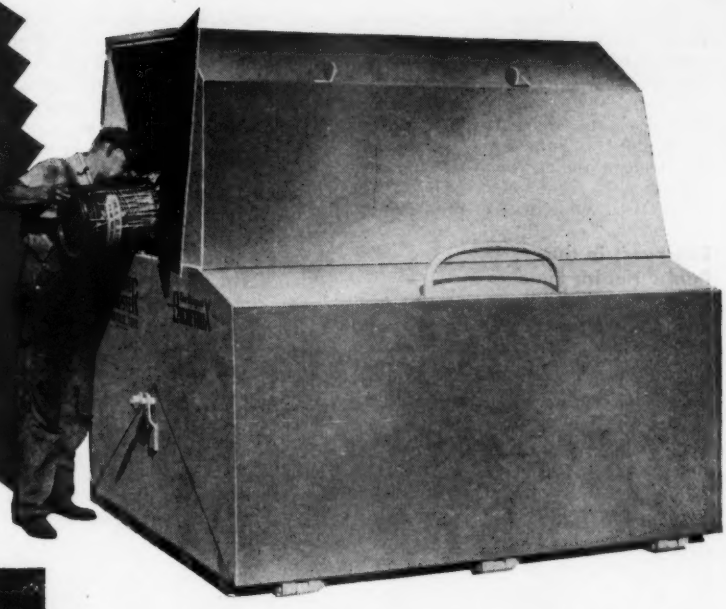
Los Angeles, Calif., after 10 years' use of a mechanical sewer cleaner, finds that it reduces cost and increases operating efficiency, by facilitating regular systematic cleaning, reducing stoppages from an average of 100 a month to 10, allowing use of the full designed capacity of the sewers, eliminating back-breaking hand rodding and hazardous conditions, eliminating obstruction of traffic during cleaning operations, and reducing the cost. By hand cleaning it took nearly a day to clean a line completely. With a power-driven cleaning machine a crew may set up in 15 or 20 locations a day, cleaning 1500 to 2500 ft. of sewer.[G23]

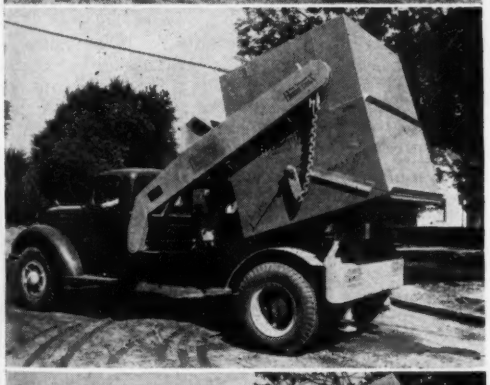
Digestion of the Mogden Works

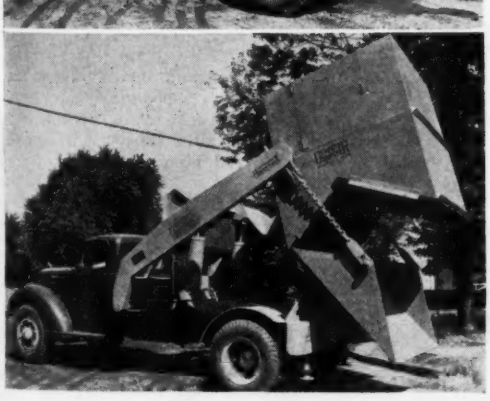
At the Mogden works of West Middlesex, England, the treatment includes activated sludge and sludge digestion. Sludge from primary digestion tanks, kept at a temperature of 85°, is pumped 7 miles to works for final digestion and drying. The pumping rate is 550 gpm, giving a velocity of 1.87 ft. per sec. in the 12" main. The friction loss for digested sludge of 96 to 97 per cent water content was about 1.4 times that for water under the same conditions. Inspection of the cast iron main had shown it to be in new condition after eight years' operation. The pumps were the horizontal, two cylinder, double-acting reciprocating type, 14" bore, 15" stroke. Fine abrasive material in the sludge had caused heavy, but not abnormal, wear of liners and piston leathers.

Originally the warm supernatant from the primary tanks was discharged directly into the influent to the sedimentation tanks; but this promoted fermentation in them, and it is now

Here's a more efficient system of TRASH and RUBBISH DISPOSAL







If your town has the problem of unsightly, unsanitary, litter-filled alleys it will certainly pay you to investigate the Dempster-Dumpster System. This remarkable system has helped dozens of towns have sanitary, efficient rubbish disposal, and at an amazingly low cost. Here's how it works. Detachable truck bodies, built in the form of rubbish depositories, are placed at needed points in the business district, factory areas, schools and housing centers. Once the rubbish is placed in the depository, no rats or flies can contaminate it . . . no domestic animal can scatter it . . . it is completely out of the reach of small children. As bodies are filled, a truck hoisting unit makes scheduled collection rounds, picking up each loaded body, in turn, hauls it . . . dumps it and returns the empty to its original position. It's as quick and simple as that . . . only one man, the driver handles the entire collection operation with the hydraulic hoist.

Savings in payroll and operational expenses are obvious when you consider that one truck hoisting unit with several bodies does the work of 4 or 5 ordinary trucks.

We manufacture bodies in various capacities and models to meet every requirement of rubbish collection. Why not write today for complete information on how the Dempster-Dumpster System can help your town toward a more efficient rubbish disposal system.

Top: 8 Cu. Yd. pyramid type body. Note convenient height and placement of doors. Above left: Hoisting unit, with 10 cu. yd. body in carrying position. Bottom: Body in dumping position . . . load is dumped automatically.

DEMPSTER DUMPSTER
TRADE MARK REG.

DEMPSTER BROTHERS, Inc., 997 Higgins, Knoxville 17, Tenn.

When you need special information—consult the classified READERS' SERVICE DEPT., *pages 69-73*

cooled and treated by prolonged settlement before being returned to the sewage and this has proved entirely successful.

Presence of yeast waste had caused trouble in the sedimentation tanks, but by dosing this with copper sulphate at the factory outlet, delaying the fermentation of the waste for an hour or two, this trouble was eliminated.[H14]

Engineers in the Public Health Field

Resulting from a study by the Committee on Municipal Public Health Engineering of the Am. Public Health Ass'n, that committee has reported that "Acceptable criteria need to be established by public health engineers for local environmental sanitation divisions as to personnel requirements, salary ranges, costs and work loads. In proposed sanitation divisions, engineer director salaries range from 65 to 80% of the corresponding health officers' salaries, whereas in established departments, engineers' salaries after long employment averaged only 62%. Per capita costs for environmental sanitation programs averaged 33 cents in the proposed divisions, with higher costs in the South and lesser costs in the East and the North Central areas. Population loads per employee in the proposed divisions averaged 13,530, with a range from south to north of 11,700 to 16,700, respectively, as compared to population loads of 21,000 to 36,000 in the Emerson report, where no geographical distinctions were made.[X3]

Steam Heating Of Raw Sludge

A plant for primary treatment with sludge digestion, filtration and drying was constructed at San Diego, Calif., in 1943 designed for 14.7 mgd; but increasing population has increased the flow to a maximum daily average of 23.0 mgd with peaks exceeding 32 mgd. The digestion system consists of three tanks of 75 ft. diameter and 33 ft. side-water depth, two with fixed roofs for primary digestion and one with floating steel dome for secondary digestion. The primary digesters were originally heated by vertical interior pipes, through which hot water was circulated. But as the amount of sludge increased beyond their rated capacity it became impossible to keep the temperature above 83° and it was decided to increase the efficiency by maintaining the temperature between 96° and 99°. This has been accomplished by preheating the sludge by injecting steam into it. A 6 ft. cube concrete box provided with an overflow weir to maintain a constant level was constructed, into which raw sludge is pumped at a uniform rate of about 113,000 gpd. Steam is introduced into it through four 3" vertical w. i. pipes, leaving them through a row of holes 6" above the bottom of the box. The sludge so heated flows by gravity to the primary tanks, alternating from one to the other at 4-hr. intervals. Water consumption for steam averages 364 cu. ft. daily and sludge gas consumption 51,500 cu. ft. The cost for heating has averaged $5.11 per 100,000 gal., not including depreciation or overhead.[H36]

Septic Tanks for Veterans Housing Program

Requirements for disposal of sewage from homes beyond sewer lines have been prepared by a committee of representatives of the several federal departments interested in the Veterans' Housing Program. Septic tanks are recommended; cesspools are not, unless approved in special cases by the State Board of Health. Grease interceptors are considered necessary for establishments with large kitchens only. Septic tanks should have a minimum capacity of 500 gal., allowing 50 gal. per person for dwellings, 25 for camps, 17 for day schools, plus adequate sludge storage; increasing the capacity by 50% if garbage grinders are used. For installations handling 1,000 gpd or more, dosing chambers are recommended, with capacity 50% to 75% of that of the field disposal lines. A distribution box is located at the upper end of the disposal field. This field should be at least 100 ft. from any water supply

well. The size of the field is determined by percolation tests as described. The effluent is usually discharged into a seepage pit with capacity at least that of the septic tank.[P23]

Fire in a Sanitary Fill

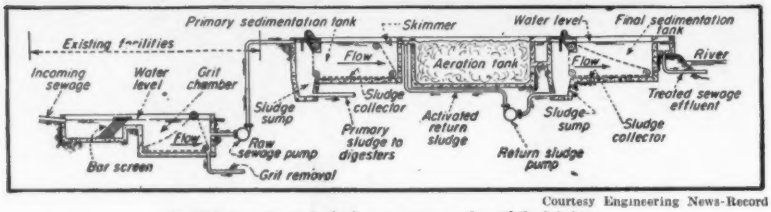
In Knoxville, Tenn., a manhole 30 ft. deep on a sewer line which was covered with sanitary fill suddenly started spouting blue flames with intense heat, acting like a Bunsen burner. The sanitary fill was started about 3 years ago. Recently the fill was completely sealed with clay on both sides and top. It is believed that the methane gas from the garbage, unable to escape from the surface of the fill, seeped through the sides of the manhole and furnished the fuel for the fire. The fire was extinguished quickly by use of carbon dioxide.[X1]

Millions Needed For Sanitary Improvements

According to the U. S. Public Health Service, new sewerage systems are needed for more than 6 million persons in towns and cities, and improved ones for 79 million. In rural areas more than 33 million have unsatisfactory sewage disposal systems, and only 6 million have satisfactory ones. To remedy these conditions would require $3,700,000,000 of sewerage facilities, $166,000,000 of garbage facilities and $1,600,000,000 of all types of sanitary facilities for rural homes. More than 9% of the needed sewerage facilities is ready for construction and 24% more is definitely planned. About one third of the 3.7 billion dollar need for sewerage is for treatment and the rest for 80,000 miles of sewers. Almost $50,000,000 should be spent for 12,000 trucks to collect refuse, $70,000,000 for 1,090 incinerators, and $25,000,000 for bulldozers and draglines to operate sanitary fills.[L6]

Disposing of Cyanide Wastes

Cyanide is found in waste waters from electroplating factories and case-hardening plants. Fish are extremely sensitive to them; solutions of potassium cyanide containing more than 0.1 ppm of prussic acid are toxic to trout. Waste waters from factories turning out cyanide wastes usually contain 200 to 1,000 times this concentration. Only a part of the cyanide is destroyed in treating sewage by biological processes, but dilution of the effluent should be sufficient to render it harmless. Another danger is to workmen in sewers; the mixing of an acid waste with a cyanide waste might produce a very lethal atmosphere in the sewer. It is desirable to remove cyanides from trade effluents before they are discharged into sewers or streams, which can be done by adding ferrous sulphate and lime to produce an insoluble precipitate containing complex cyanides of iron. The dosages may need to be relatively heavy in some



Courtesy Engineering News-Record

Modified activated sludge treatment for Philadelphia.

cases. It was rather surprising to find that filters recover quickly from an upset caused by a moderate dose of cyanide, and seem capable of adjusting themselves to a steady dosage of cyanide.[I 12]

Modified Activated Sludge at Philadelphia

Philadelphia, Pa., has begun construction of a treatment plant to replace an existing Imhoff tank serving the northeast drainage district. The plant, designed for 125 mgd of sewage with 200 ppm of suspended solids and of B.O.D., will include coarse screening, mechanical grit removal, primary sedimentation, aeration, final sedimentation, storage for withdrawn sludge, external sludge heating, 2-stage digestion, supernatant aeration, gas collection, and lagooning of digested sludge.

The influent channel feeding the 4 primary tanks through 12 branches is reduced gradually both in width and by an upward-sloping bottom. Sludge and scum will be removed by longitudinal scrapers and about 10 mgd returned from final to primary tanks. Primary sludge will be pumped into storage tanks, withdrawn from these, heated, and forced to digestion units. That part of the concrete in the settling tanks that is above the water line is made corrosion-resistant by use of calcium aluminate, hydraulic cement and inert aggregates, and a band of vitrified clay plates will be placed at and above the water line in these and in the aeration tanks; and in the latter all concrete surfaces above the plates except walkways will be coated with a bituminous compound. Aeration is designed for 0.4 cu. ft. per gal., the air being purified by electronic air filters known as electrostatic precipitators. The eight digestion tanks will operate in two batteries, each with three primary and one secondary tanks. Primary digesters will operate in 12 hr. cycles—2 hr. charging, 6 hr. resting, 1 hr. decanting supernatant, 1 hr. resting, 1 hr. withdrawing sludge and 1 hr. undisturbed. The sludge drawn from the storage tanks will be preheated to 110° and pumped to digesters, which will be kept at 85°. Recirculated supernatant, discharged one foot below the top of the layer, will be used to control floating scum.[E13]

Effect on Fish of Chlorinating Effluents

Chlorinating sewage plant effluents to eliminate danger from bathing in the diluting stream has been advocated by many in England, and the matter was studied by the Water Pollution Research Board. The Board reported that most of the bacteria would be killed if the dose of chlorine was large enough—5 or 6 ppm was necessary in one case. But the residual chlorine might be fatal to fish; 0.3 ppm was found to be fatal to trout. During the tests it was found that reaction of chlorine with certain industrial wastes (particularly thiocyanates) greatly increased the toxicity. The addition of 1.0 ppm of chlorine to a non-toxic solution containing 0.15% of spent gas liquor killed fish in less than an hour.[I 13]

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An All-Welded Grandstand

An all-welded steel grandstand, made of pipe reclaimed from oil lines, has been erected in Wichita Falls, Tex., for use by the baseball club. The framework of the structure is 4" and 5½" pipe, while bracing, roof supports and seat supports are 4". The grandstand is 480 ft. long, has a maximum height of 28 ft. and seats 8,000.

When you need special information—consult the classified READERS' SERVICE DEPT., *pages 69-73*

PUBLIC WORKS Equipment News

Using the Goldak "featherweight."

How to Locate Pipes Easily

This is a "featherweight" pipe locator, weighing only 11 pounds and easily usable for every operation in a pipe or cable survey. It traces, centers and measures depths without any connection to pipe, cable or earth. The one control on the receiver and one on the transmitter insure easy and simple operation. It gives a sharp signal response. For information on this and other Goldak pipe locators, write Goldak Co., 1544 W. Glenoaks Blvd., Glendale 1, Calif.

Small Scale Biofiltration

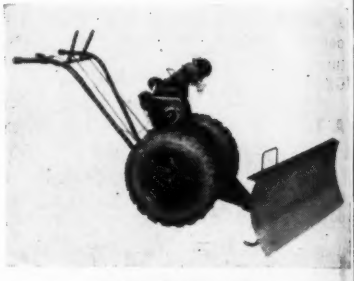
The Dorr Co., 570 Lexington Ave., N. Y., has combined the Dorr Duo-Clarifier and the Duo-Filter making small scale biofiltration possible with two units, even when two-stage treatment is desired. A partition divides the clarifier into primary and secondary settling compartments. The duo-filter is simply two stages of filters arranged concentrically in a single circular container and served by a single distributor which doses the two sections separately. Leaflet 7312, sent on request, gives operating data on two small milk waste treatment plants having flows of 21 and 31 gpm. respectively.

Sidewalk Snow Plow and Power Mower

This combination offers an opportunity for summer use in parks or around sewage treatment or water plants and the creation of taxpayer good will in the winter by plowing sidewalks. Rubber tires are now furnished on the Cunningham mower, which has a sickle bar cutting 3 ft. wide. The same unit can be equipped with a 40-inch snow plow. In addition to plowing sidewalks, such a unit can save time and money by plowing snow around the sewage treatment and water plant, and in many other places. For complete information, write James Cunningham, Sons & Co., 13 Canal St., Rochester 8, N. Y.

A Dump Truck With Completely Automatic Hydraulic Cab Control

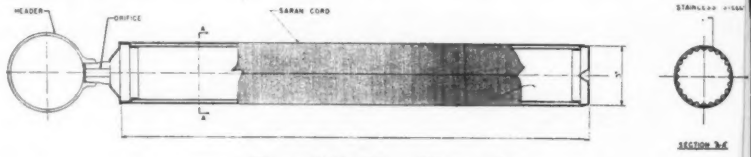
This "pick-up" dump is easily adaptable to almost every make and body style of truck in the ½, ¾ and 1-ton field; it is available either as a complete unit with dump body or as a kit for the conversion of standard units to this handy form. It has completely automatic hydraulic cab control which saves time and makes this unit specially valuable on short haul work and for small bulk-handling jobs. Full information on applicability and savings available from National Truck Equipment Co., Waukesha, Wisc.



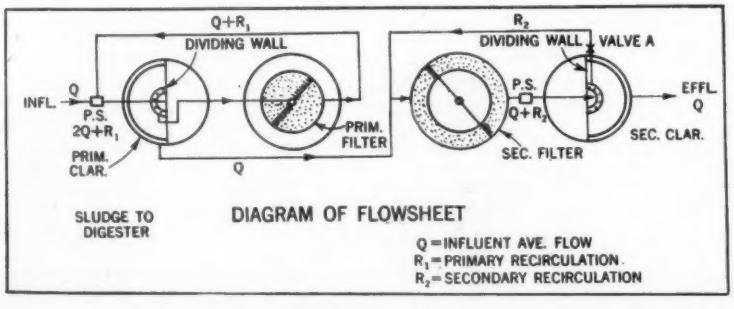
Sidewalk snow plow.

An Air Diffusion Tube With Many Advantages for Sewage Treatment

A new type of air diffusion tube for use in activated sludge sewage treatment and for air diffusion and gas mixing in industry has been developed by the Chicago Pump Co., 2348 Wolfram St., Chicago, Ill. This tube is made of corrugated stainless steel, mechanically wound with Saran plastic cord, and is 60% lighter than previous diffusion media. The wall depth is one-sixth of that used previously, reducing clogging and simplifying cleaning; uniform fine-bubbled diffusion occurs over the entire surface of the tube at all air rates; and there is no progressive clogging. The relative lightness of this new construction allows more economical application of the Swing Diffuser equipment. A 4-page bulletin describing this new equipment for sewage treatment will be sent on request. See address above.



Views of Precision diffuser tube.



Dorr units for small scale biofiltration.

Four Major Improvements in This Loader

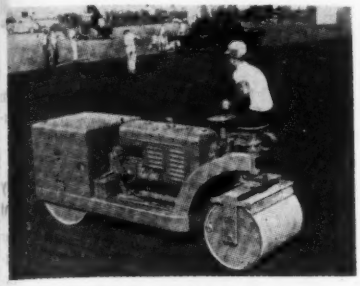
Four major improvements have been incorporated in the new Eagle Model 400 truck-mounted loader used for handling stone, sand, slag, snow and other loose materials. This loader is especially adapted to city street work, county and state highway work and contractors. The four major improvements are (1) Full hydraulic control, assuring speedier operation, and 3 to 5 yard per minute

capacity; (2) lower overhead clearance, so that no adjustment is necessary where clearances are as much as 11′ 10″; (3) use of a conveyor belt discharge operating around a 180° arc and capable of discharging wet material without depending on gravity flow; and (4) a positive crowd assuring backward or forward movement. This loader can be mounted on any new or used 1½ or 2-ton truck; power is supplied through a power take-off; weight is 11,500 pounds complete. For details and literature write Eagle Crusher Co., Inc., Galion, Ohio.

Eagle truck-mounted loader.

A Tandem Roller for Quick Work and Close-Up Jobs

This is a variable weight tandem roller, 3 to 4 tons, with Allis-Chalmers power and a turning radius of 12 ft.



Wheeler tandem roller.

The compaction roller gives 150 pounds compression per lineal inch, with ballast; the steering roller, 70 pounds. Roller bearings are used throughout, and the roller has electric starting. Operation is simple and permits close-up work. A 6-page folder with full description is available from the Wheeler Roller Division, Shaw Sales & Service, 5102 Anaheim-Telegraph Road, Los Angeles 22, Calif.

For Better Garbage Disposal

A home pulverator for disposal of garbage through the kitchen sink has been announced by Given Mfg. Co., Los Angeles, Calif. This is designed to grind up household garbage, including bones, rinds and fruit pits, and to discharge it with the sewage through the house sewer. The unit can be installed in any sink with a drain opening of 3½ to 4 ins.

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TECHNICAL MEETINGS

The AWWA and the FSWA Conventions

The joint meeting of the American Water Works Association and the Federation of Sewage Works Association was held in San Francisco, Calif., July 21 to 25. The meeting was an excellent one and well attended. A special train carried a good many convention-goers to the Coast from the East; others flew, went by train or drove, so that representatives from the East were numerous. Technical sessions were excellent and, in general, well attended. The technical exhibits were unusually outstanding and reflected the progress made since the close of the war. San Francisco weather was perfect during the week and none of those attending the convention appeared to suffer from lack of good food. The sights of San Francisco, bridge games and other attractions filled in all of the spare hours of the convention week.

The convention affairs were remarkably well run and the entertainments provided by the Manufacturers' Association were the best in a long time.

American Road Builders' Association

The 45th annual convention of the American Road Builders' Association will be held in Washington, D. C., Jan. 26 to 28, 1948. This will be primarily a technical session preliminary to the Road Show in Chicago. Charles M. Upham, ARBA, International Building, Washington 4, D. C., is Managing Director.

Georgia Water and Sewage School

The 16th annual Water and Sewage School will be held in Atlanta, Ga., Sept. 17-19, at the Georgia School of Technology. In addition to the instruction on all types of water and sewerage systems, with opportunity for questions by the operators, repair and maintenance schools will be conducted throughout the entire period. For fuller information write W. H. Weir, State Department of Health, Atlanta, Ga.

Inter-American Sanitary Engineering Conference

The third Inter-American Sanitary Engineering Conference will be held in Santiago, Chile, Nov. 20 to 27. Full information on the technical and social programs can be obtained from Donald L. Snow, Inter-American Association of Sanitary Engineering, 17th & Constitution Ave., Washington 6, D. C.

Ohio Conference on Sewage Treatment

The 21st meeting of the Ohio Conference on Sewage Treatment will be held at the Deshler-Wallick Hotel, Columbus, O., on Oct. 2 and 3. The Ohio Section of the AWWA will hold a meeting on Sept. 30 and Oct. 1, also in Columbus. Full information from G. A. Hall, State Department of Health, Columbus, O.

PERSONAL NEWS

Gannett Fleming Corddry and Carpenter, Inc., Harrisburg, Pa., have been retained as consulting engineers by the Pennsylvania Turnpike Commission to survey, lay out and estimate the cost and probable toll receipts for the extension of the turnpike eastward from Carlisle to Philadelphia.

Damon Runyan has purchased the interests of Angus E. Slee in the consulting engineering firm of Runyan & Slee and will continue the business under his own name at Box 58, Longmont, Colo. Mr. Slee has been appointed city engineer of Longmont.

S. R. Ives has been elected president of Armco Drainage and Metal Products, Inc., Middletown, O., and *M. C. Patton* and *H. D. Neill* vice-presidents.

Edward A. Reinke has been appointed chief of the Bureau of Sanitary Engineering, California Department of Health, succeeding C. G. Gillespie, retired.

1947 GMC Trucks

Appearance changes, new cab construction in the lighter and medium weight models and increased horsepower for the heavier units are among the many improvements announced by GMC Truck and Coach Division of General Motors Corp., Detroit, Mich. Power of the heavier gasoline models has been increased about 10% and of the 4 and 6-cylinder diesels about 21%. New styling changes the appearance of these trucks.

Annual Review by Allis-Chalmers

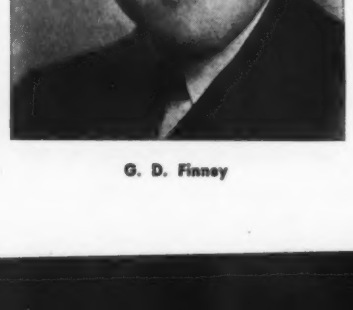
The 1947 Annual Review has been published by Allis-Chalmers Mfg. Co. This is a fine 32-page book covering the many fields in which that company is interested. Our readers will be interested mainly in *Construction and Public Works* and in *Rock Products*, but will find at least several of the other 13 headings also of value. It will be sent on request to the company.

U. S. Pipe Personnel Changes

After long service, Robert W. Martindale, W. G. Savage and Thomas Simons, of the West Coast Office of Unites State Pipe and Foundry Co. have retired. New appointments to top positions have been announced as follows: A. R. Hasumann, Pacific Coast Sales Manager; P. King Farrington, assistant; Carl N. Brown and J. Leslie Hart, Western Manager and Assistant, respectively; and T. W. McCreery and Robert C. Lemert, Southern Sales Manager and Assistant, with office in Birmingham.

Boyd Heads Galion Sales; Monnett and Finney Promoted

C. F. Boyd has been elected vice-president of Galion Iron Works & Mfg. Co., in charge of sales. *Robert C. Monnett*, division engineer of the Ohio Highway Department until he joined Galion in 1945, has been appointed sales manager of the Eastern and Central Divisions; and *G. D. Finney*, long-time employe of the company, has been appointed to be sales manager of the Western and Southern Divisions.



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545. Finding Buried Pipe, Leaks is easy with the new Featherweight Goldak Pipe Locator. An easy-to-read illustrated bulletin tells the full story quickly. Address: The Goldak Co., 1544 W. Glenoaks Blvd., Glenade 1, Calif.

Want Mosquito and Pest Controls?

607. Two informative folders available now describing and suggesting uses for Neocid M 25 and Neocid D 30, for effective sprays. Address: Geigy Co., Inc., Insecticide Div. 89-91 Barclay St., New York 8.

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These Wheel Tractors Solve Many Hauling Problems

4. Specifications and full information about the new M-M wheel tractors in sizes 27 HP to 49 HP. Send for copies today. Dept. PW, Minneapolis-Moline Power Implement Co., Minneapolis, Minn.

Data on All Types of Bins and Batching Plants

11. Good illustrations and useful data on all types of Heltzel Highway Bins, for truck mixer charging, bulk cement plants, enclosed bucket elevators, belt conveyors, etc. Heltzel Steel Form & Iron Co., Dept. P.W., Warren, O.

Self-Propelled Crane for Every City-County Need

20. Here's a fast, versatile industrial crane with plenty of lift . . . gets there in a hurry on rubber tires . . . one man operates it easily . . . 5 ton capacity—7 ton with outriggers. Send for bulletin PW, Unit Crane & Shovel Corp., 6323 West Burnham St., Milwaukee 14, Wisc.

Travels Fast, Loads All Kinds of Materials Quickly

22. New Eagle Truck-Mounted Loader, operated by truck driver, goes from job to job at truck speed. Loads all kinds of material quickly. No costly working parts. Ask for new bulletin PW. The Eagle Crusher Co., Inc., Galion, Ohio.

Improve Appearance of Curbs, Gutters, Sidewalks

78. Curb and Gutter and Sidewalk Forms, including battered face curb form especially for modern traffic conditions. Last 20 years or more. Send for new engineering data Bulletin A-20-F, Dept. P.W., Heltzel Steel Form & Iron Co., Warren, O.

Handle All Kinds of Tough Grading Jobs Economically

98. The Austin-Western 99M Power Grader with its powerful all wheel drive handles difficult jobs with economy and efficiency; and does better work on grading, ditching, scarifying, snow ploughing, loading, mixing, bulldozing, shoulder trenching and backsloping. Write for Bulletin 1948. Dept. P.W., Austin-Western Co., Aurora, Ill.

Save Money, Busting, Cutting, Digging, etc.

110. Powerful self-contained gasoline hammers illustrated in new booklet. Used as paving breakers and spike drivers. Easily portable, economical. Write Syntron Co., 660 Lexington, Homer City, Pa.

Methods of Installing Steel Sheet Piling

112. Illustrated descriptions of both standard and interlock corrugated steel sheet piling of minimum weight, maximum strength, ease of handling with methods of installation are contained in a booklet. If you have a job involving piling write Caine Steel Co., Dept. P.W., 1820

Reliable Every Purpose Pumps

117. New brochure by Gorman-Rupp Co., Mansfield, Ohio, illustrates and describes many of the pumps in their complete line. Covers heavy duty and standard duty self-priming centrifugals, jetting pumps, well point pumps, triplex road pumps and the lightweight pumps.

For Reliable Low-Cost Light and Power Anywhere

392. 20-page catalog P.W. describes "Dieselectric" plants 3 to 10 KVA, and diesel engines from 4 to 12 H.P. These are easily transported and will produce reliable, low cost light and power anywhere. Write WITTE ENGINE WORKS, Division of Oil Well Supply Company, Kansas City 3, Mo.

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524. Tested under severest conditions of long, hard use, these engines have earned world wide recognition as the "night" power for hundreds of applications. Get latest bulletin from Dept. PW, Briggs and Stratton Corp., Milwaukee 1, Wisc.

Stationary Power Units for Power, Economy and Efficiency

530. Data sheets and specifications give full details of Minneapolis-Moline Power Units in sizes from 26 HP to 88 HP burning gasoline and 88 HP burning butane gas. Write Dept. PW, Minneapolis-Moline Power Implement Co., Minneapolis 1, Minn.

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540. New Odometer measures as you walk. Ingenious labor and money saver for surveyors described in illustrated circular. Address: Matthews Instrument Co., 1129 Boylston St., Newton Upper Falls 64, Mass.

Need an Efficient, Economical Air Compressor?

543. Davey Air Compressors, either trailer type or truck mounted, offer efficient and economical operation. For details on models 105 and 210 write Dept. P.W., Davey Compressor Co., Kent, Ohio.

Mechanical Testing Screen For Stone, Gravel, Slag, etc.

606. Gives fast, accurate sizing of test samples. The Gilson Testing Screen handles a large sample in three to five minutes. For bulletin giving complete details on this screen which has a size range from 4 inches to 200-mesh write Dept. P.W., Gilson Screen Co., Box 186, Mercer, Pa.

SNOW FIGHTING

For High-Speed Snow Removal

350. "Frink One-Way Sno-Plows" is a four page catalog illustrating and describing 5 models of One-Way Blade Type Sno-Plows for motor trucks from 1½ up to 8 tons capacity. Interchangeable with V Sno-Plow. Frink Sno-Plows, Inc., Clayton, 1000 Islands, N. Y.

Fast, Efficient Skid-Proofing

355. Get full facts about Baughman Light-Weight Cinder Spreaders, fast operators for cinders, sand, salt, chips, etc. Free flowing at low temperatures. 9-17 cu. yd. cap. Write Dept. P.W., Baughman Mfg. Co., Inc., Jerseyville, Ill.

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How to Use Less Labor in Resurfacing

15. You can mechanize your resurfacing with these Portable Bituminous Mixers. 6 to 14 ft. sizes for resurfacing and maintenance. Helpful booklet issued by The Jaeger Machine Co., 400 Dublin Avenue, Columbus 16, Ohio.

Levels Sidewalks and Curbs Quickly and Easily

107. How the Mud-Jack Method for raising concrete curb, gutter, walls and streets solves problems of that kind quickly and economically without the usual cost of time-consuming reconstruction activities—a new bulletin by Koehring Company,

3026 West Concordia Ave., Milwaukee 10. Wis.

Speed Your Work With These Powerful Motor Graders

128. Two powerful Galion motor graders designed to answer every requirement for more speed in road, airport, dam and housing construction work are fully described in a folder illustrated with many action pictures. Issued by Galion Iron Works & Mfg. Co., Galion, Ohio.

Strong, Speedy, Low-Cost Maintainer Has Many Uses

130. BG Maintainer, a powerful speedy, low-priced machine for light road maintenance. Full details in illustrated folder. Huber Mfg. Co., Dept. P.W., Marion, Ohio.

Tandem, 3 Wheel and 3 Axle Road Rollers

138. "The Buffalo-Springfield" line of road rollers (tandem, 3-wheel, and 3-axle) are described in the latest catalog P.W. issued by the Buffalo-Springfield Roller Co., Springfield, Ohio.

Here's a Roller for Every Need

141. Three-Wheel and Tandem Rollers, 5 to 8-ton and 10 & 12 ton sizes: also variable weight tandem roller for new highway surfacing and old road conditioning. Ask for new bulletin. Dept. P.W., Huber Mfg. Co., Marion, Ohio.

Looking Into Soil Stabilization?

154. "Soil Stabilization with Tarvia" —An illustrated booklet describing the steps in the stabilization of roadway soil with Tarvia will be mailed on request by Dept. P.W., The Barrett Division, 40 Rector St., New York 6, N. Y.

Mix-in Place Roadbuilders Save on Scarce Labor

187. Mix-in Place Roadbuilders. Bituminous Pavers, Concrete Bituminous Finishers. Adjustable Spreaders, Forms, etc. —4 complete catalogs in one cover, issued by the Jaeger Machine Company, 400 Dublin Ave., Columbus 16, Ohio.

Here's Your Diesel Tractor!

190. Big 48 page catalog describes and lists many uses for International Diesel Tractors. Write International Harvester Co., Dept. P.W., 180 North Michigan Ave., Chicago 1, Ill.

Latest Maintenance Equipment For Blacktop Roads

290. "Blacktop Road Maintenance and Construction Equipment" — Asphalt and tar kettles, flue type kettles, spray attachments, tool heaters, surface heaters, road brooms and rollers. This is modern and up-to-date equipment for blacktop airport and road construction and maintenance. Write for Catalog R. Littleford Bros., Inc., 452 East Pearl St., Cincinnati 2, Ohio.

Mow Clean and Fast In Tight Corners

510. Send for latest literature about the Cunningham Mower for Fence Rows, Parking Areas, Driveways, Picnic Grounds and many other jobs. 3 ft. cut, variable speed, rugged, easy to handle. James Cunningham, Son & Co., Dept. 16, 13 Canal St., Rochester 8, N. Y.

All Purpose Spreader Spreads 2 to 10 ft. Wide

514. Saves labor, spreads 0 to 100 lbs. a sq. yd., dust up to 1" material, forward, reverse, on curves, hills or straightaway. Assures uniform, even density of spread. Write for bulletin: Dept. PW, All Purpose Spreader Co., Fuller Rd., Elyria, Ohio.

SEWAGE DISPOSAL

Non-Corrosive, Long Lasting Low Cost of Sewer Pipe

72. Get this new engineering data on clay pipe for sewers. Withstands acid, alkali and gas attacks indefinitely. Cuts maintenance costs to a minimum. Write Dept. P.W., National Clay Pipe Mfrs., 111 W. Washington St., Chicago 2, Ill.

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Does Air Sabotage Your Pipe Lines and Pumps?

357. Automatic Air Release Valves for water, sewage and industrial uses automatically vent air accumulations. Ask for latest illustrated engineering bulletins. Simpex Valve & Meter Co., 6750 Upland St., Philadelphia 42, Pa.

Valuable Booklet on Porous Diffuser Plates and Tubes

367. A valuable booklet on porous diffuser plates and tubes for sewage treatment plants. Covers permeability, porosity, pore size and pressure loss data, with curves. Also information on installations, with sketches and pictures, specifications, methods of cleaning and studies in permeability. 20 pp. illustrated. Write to Norton Company, Dept. P.W., Worcester 6, Mass.

How You Can Clean Sewers From Streets Easily and Inexpensively

386. 32-page illustrated booklet explains how a city can clean its sewers and culverts with its own forces using the up-to-date Flexible Sewer Rod equipment. Illustrates and describes all necessary equipment. Issued by Flexible Sewer Rod Equipment Co., 9059 Venice Boulevard, Los Angeles 34, Calif.

How Cities Can Do Complete Sewer Cleaning From Street

387. Literature illustrating how cities, towns and villages using OK Champion Sewer Cleaners are doing a complete sewer cleaning job from street level. Three sizes of machines available in addition to full line of sewer rods and accessories. Issued by Champion Corporation, 4752 Sheffield Avenue, Hammond, Indiana.

How to Select Main Line Meters

432. New bulletin illustrates Builders Air Relay system for liquids containing suspended solids like sewage. Eliminates corrosion, clogged pipes, etc. "The Selection of Main Line Meters," a highly informative and useful presentation, describes forms of differential producers and quickly solves typical problems with the use of graphic charts. Write Builders-Providence, Inc., Dept. P.W., 9 Codding St., Providence 1, R. I.

How to Make Concrete Pipe on the Job

440. Making concrete pipe on the job to give employment at home is the subject of a booklet sent on request by Quinn Wire & Iron Works, 1621 12th St., Boone, Ia., manufacturers of "Heavy Duty" Pipe Forms.

Interesting Facts About Transite Pipe

445. Two new illustrated booklets, "Transite Pressure Pipe" and "Transite Sewer Pipe" deal with methods of cutting costs of installation and maintenance of pipe lines and summarize advantages resulting from use of Transite pipes. Sent promptly by Johns-Manville Corp., Dept. P.W., 22 East 40th St., New York 16, N. Y.

How to Make Better Sewer Pipe Joints

447. How to make a better sewer pipe joint of cement—tight, minimizing root intrusion, better alignment of joint. Permits making joints in water-bearing trenches. General instructions issued by L. A. Weston, Dept. P.W., Adams, Mass.

How to Get Automatic Removal of Screenings

460. Be assured of uninterrupted, constant automatic removal of screenings. Folder 1587 tells how. Gives some of the outstanding advantages of "Straightline Bar Screens" (Vertical and inclined types). Link-Belt Co., Dept. P.W., 2045 W. Hunting Park Ave., Philadelphia 40, Pa.

An Incinerator Necessity

463. Recuperator tubes made from Silicon Carbide and "Fireclay" Corebusters for maximum efficiency are described and illustrated in bulletin No. 11 issued by Fitch Recuperator Co., Dept. P.W., Plainfield National Bank Bldg., Plainfield, N. J.

How You Can Dispose Of Sewage Solids

464. Nichols Herreshoff incinerator for complete disposal of sewage solids and industrial wastes—a new booklet illustrates and explains how this Nichols incinerator works. Pictures recent installations. Write Dept. PW, Nichols Engineering and Research Corp., 60 Wall Tower, New York 5, N. Y.

Ask for This Design Data On Sprinkling Filters

469. Design data on sprinkling filters of Separate Nozzle Field and Common Nozzle Field design as well as complete data on single and twin dosing tanks, and the various siphons used in them, for apportioning sewage to nozzles. Many time-saving charts and tables. Write Pacific Flush Tank Co., Dept. P.W., 4241 Ravenswood Ave., Chicago 13, Ill.

How the Hydro-Treator Works

486. 28-page catalog describes and illustrates the Dorrco Hydro-Treator, a self-contained water treatment unit combining Flocculation, Sludge Thickening and Clarification. Reduces treatment time and lowers plant construction costs. The Dorr Co., Dept. P.W., 570 Lexington Ave., New York 22, N. Y.

Packaged Sewage Treatment—Just Right for Small Places

488. "Packaged" Sewage Treatment Plants specifically developed for small communities — 100 to 3,000 population. Write for full description and actual operating data for this type of plant. Chicago Pump Co., 2348 Wolfram St., Chicago 18, Ill.

Look Into This Sewage Treatment Equipment

490. New bulletin P.W. fully describes and illustrates Hardinge sludge collectors for clarifiers, sludge concentration and skimming in both circular and rectangular tanks. Write Dept. P.W., Hardinge Company, Inc., York, Pa.

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Need Equipment for Small Sewage Plant?

491. Small type Conveyor Sludge Collector and Skimmer, Grit Collector, Aero-Filter and other equipment for small sewage treatment plants are described and illustrated in bulletins from Chain-Belt Co., 1722 West Bruce St., Milwaukee 4, Wis.

Glazed Clay Blocks for Trickling Filter Underdrains

492. Illustrated bulletin describes the Natco Unifilter block of glazed, hard burned clay for underdraining filter beds. Write National Fireproofing Corp., Pittsburg 12, Pa., for free copy.

Filter Blocks for Any Trickling Filter Installation

544. Accelo Hi-Cap Filter underdrain blocks are designed to meet every requirement of trickling filter operation. For folder giving specifications, dimensions and details of construction write Infilco, Inc., 325 West 25th Place, Chicago 16, Ill.

Low Cost Air for Sewage Disposal

602. All interested in low cost air for sewage disposal will want a copy of this useful booklet. Describes operating principles and specifications of Roots-Connersville Aerating Blowers. Write to Roots-Connersville Blower Corp., 301 Valley Ave., Connersville, Ind.

WATER WORKS

Hydraulic Pipeline Scraper For Water and Sewage Mains

382. For a copy of this compact folder on a hydraulic pipeline scraper which cleans all kinds of mains from 4 inches to 14 inches write to Dept. PW, Carver-Stimpson Pipe Cleaning Co., Walters, Okla.

Solve Corrosion Problems With This Special Alloy

391. "Everdur Metal" is title of an 8-page illustrated booklet describing advantages of this corrosion-resisting alloy for sewage treatment equipment, reservoir, and waterworks service. Dept. P.W., the American Brass Co., 25 Broadway, N. Y. C.

Make Water Extra Safe

399. Safe water may be one of the civic improvements your citizens expect soon. Feeders of all types including Hypochlorinators, Reagent Feeders, Dry Chemical Feeders, Chlorinators and Ammoniators for feeding all of the usual chemicals used in sanitation practice. Ask for latest catalogs. Dept. P.W., Wallace & Tiernan Co., Newark 1, N. J.

Helpful Data on Hydrants

405. Specifications for standard AWWA fire hydrants with helpful instructions for ordering, installing, repairing, lengthening and using. Issued by M. & H. Valve & Fittings Co., Dept. P.W., Anniston, Ala.

Chem-O-Feeders for Automatic Chemical Feeding

400. For chlorinating water supplies, sewage plants, swimming pools and feeding practically any chemical used in sanitation, treatment of water and sewage. Flow of water controls dosage of chemical; reagent feed is immediately adjustable. Starts and stops automatically. Literature from % Proportioneers, Inc. %, 96 Codding St., Providence 1, R. I.

All Kinds of Valves And Hydrants

407. Hydrants and Valves. Catalog P. W. covers fire protection appliances, including hydrants, gates and check valves. Catalog also describes sluice gates, shear gates, and flap, mud, gate, check and foot valves. Address: Mueller Company, Chattanooga, Tenn.

It's Easy to Use This Leak Locator

426. Leak Locators. Again available to waterworks superintendents, the Globe line of leak locators, dipping needles and pipe finders. Several leaflets describing the original Geophone leak locator, Little Wonder pipe phone, and the Magnetite Dipping Needle. Globe Phone Mfg. Corp., Dept. P., Reading, Mass.

Find Your Leaks In a Jiffy

427. For tracing buried pipes and finding hidden leaks get details of Allen-Howe Leak Detectors, Pipe Locators, Dipping Needle and Pipe Phones. Ask for new circular P.W. 6, Allen-Howe Electronics Corp., 150 Main St., Peabody, Mass.

What You Should Know About Meter Setting and Testing Equipment

431. The most complete catalog we have seen on setting and testing equipment for water meters—exquisitely printed and illustrated 48-page booklet P.W. you should have a copy of. Ask Ford Meter Box Co., Wabash, Ind.

Cast Iron Pipe and Fittings For Every Need

437. Cast iron pipe and fittings for water, gas, sewer and industrial service Super-deLavaud centrifugally-cast and pit-cast pipe. Bell-and-spigot, U. S. Joint, flanged or flexible joints can be furnished to suit requirements. Write U. S. Pipe and Foundry Co., Dept. P.W., Burlington, N. J.

Do You Have This Data On Cast Iron Pipe?

438. "Cast Iron Pipe and Fittings" is a well illustrated 44 page catalog giving full specifications for their complete line of Sand Spun Centrifugal Pipe, Fire Hydrants, Gate Valves, Special Castings, etc. Will be sent promptly by R. D. Wood Co., Dept. P.W., Public Ledger Building, Independence Square, Philadelphia 5, Pa.

NOTICE

Invitation to Bidders

Sealed bids will be received by the Town of Norton, Virginia, until December 11, 1947, at 10:30 A. M., for the construction of a 720,000 gallon per day filter plant, complete, as described by "Specification for Filter Plant for Town of Norton, Virginia."

Bids shall be on bidder's own form, enclosed in a sealed envelope, addressed to W. P. Kanto, Town Manager, Norton, Virginia, and shall be plainly marked on the outside of the envelope "Proposal for Construction of Filter Plant."

Bids shall be opened at the meeting of Town Council, Norton, Virginia, at 10:30 A. M., December 11, 1947.

Specifications may be obtained from the Town Manager, Norton, Virginia.

The right is reserved to accept any bid, or to reject any or all bids, and to waive all technicalities in receiving of proposals.

Each bid shall be accompanied by a certified check, or bid bond, in an amount not less than ten percent of the amount of the bid, made payable to the Town of Norton, Virginia. These checks or bid bonds will be returned to all unsuccessful bidders, and will be returned to the successful bidder, to whom the contract is awarded, after the contract has been executed.

The successful bidder, to whom the contract is awarded, will be required to furnish the town, along with the executed contract documents, a contract bond in the amount of 100% of the contract price.

TOWN OF NORTON, VIRGINIA.
By W. P. Kanto
Town Manager.

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Makes Underground Pipe Installations Easy

444. One-man-operated Hydraulic Pipe Pusher pushes pipe through ground under streets, sidewalks, lawns and other obstacles. Pays for itself in man hours saved on first few jobs. For complete facts and prices, ask for booklet S-117, Greenlee Tool Co., 2042 Columbia Ave., Rockford, Ill.

Need a Water-Tight Pipe Joint?

449. Full information on "Hydro-Tite" jointing compound for bell and spigot pipe, together with specifications, instructions; and illustrations both on it and "Fibrex" sanitary joint packing are contained in handsome 48-page booklet. Address: Hydraulic Development Corp., Dept. P.W., 50 Church St., New York.

How to Estimate Quantity Of Joint Compound Needed

450. The uses of Tegul-Mineralead for bell and spigot pipe and G-K Sewer joint compound are described in a 16-page illustrated booklet issued by Atlas Mineral Products Co., Mertztown, Pa. Includes useful tables for estimating quantities needed.

Data on High Efficiency Well Water Systems

454. Installation views and sectional scenes on Layne Vertical Centrifugal and Vertical Turbine Pumps fully illustrated and including useful engineering data section. Layne Shutter Screens for Gravel Wall Wells. Write for descriptive booklet P.W., Adv. Dept., Layne & Bowler, Inc., Box 186, Hollywood Station, Memphis 8, Tenn.

Oil or Water Lubricated Turbine Pumps

456. Oil lubricated turbine pumps with open impellers. Five types of heads available. Specifications and illustrations in new bulletin 6930M-2 issued by Fairbanks, Morse & Co., Dept. P.W., 600 So. Michigan Ave., Chicago 5, Ill.

Want Clear, Soft, Iron-Free Water?

467. Water Softening. The use of the Spaulding Precipitator to obtain maximum efficiency and economy in water softening is described in this interesting technical booklet. Permutit Co., Dept. P.W., 330 W. 42nd St., New York 18, N. Y.

Are You Thinking About A Swimming Pool?

472. Data and complete information on swimming pool filters and recirculation plants; also on water filters and filtration equipment. For data, prices, plans, etc., write Roberts Filter Mfg. Co., 640 Columbia Ave., Darby, Pa.

Have You a Water Conditioning Problem?

481. Installation-tested equipment for complete municipal and industrial systems or individual units. Illustrated and described in latest booklets from Dept. P.W., American Wells Works, Aurora, Ill.

Treating Water With Copper Sulphate

496. "Use of copper sulphate in water treatment plants" contains valuable data on chemicals, dosage, etc. Ferri-floc Ferric Sulphate—a new, valuable booklet P.W. on coagulation for water and sewage treatment plants. Write Tennessee Corporation, Atlanta 1, Ga.

Outdoor Water Service Devices That Do Not Freeze

506. Data on anti-freeze outdoor drinking fountains, hydrants, street washers, etc., contained in Catalog L. Sent promptly on request to Murdock Mfg. & Supply Co., 426 Plum St., Cincinnati 2, Ohio.

Here's Data on All Swimming Pool Needs

508. Well illustrated bulletin describes Filters, Water Softeners, Hydrogen Ion Plants and Complete Equipment for Swimming pools, etc. Copy sent on request by Dept. PW., Chemical Equipment Co., 223 Center Street, Los Angeles 54, Calif.

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JOBS FOR ENGINEERS

A mid-west manufacturer of water purification equipment needs two "good sales engineers . . . for work in Indiana and Illinois . . . on a commission basis, $6000 to $8000 per year for the right man." Write GFC, care this magazine.

A civil engineer, about 35, with professional experience in the design and layout of hydraulic systems and structures is needed by an Ohio firm of consulting engineers. Write AES, care of this magazine, for further information.

Philippine Military Merit Medal to Lloyd Clark and Others

The Philippine Commonwealth some time ago awarded the Military Merit Medal to the following: Lt. Cols. L. K. Clark and Herman Elder; Majors Leroy Scott, Guy Griffin and Ben Whisler; Capt. M. J. Noth; and Sgt. John Postma. The award was for "meritorious service . . . in the repair and reinstallation of the water supply for the city of Manila and its suburbs after . . . great damage by war operations. . . . By their high technical knowledge, superior judgment and sincere interest in the welfare of the people, the tremendous work . . . was successfully accomplished."

CONSTRUCTION OF BOOSTER PUMPING STATION AND FOR THE REMODELLING, ENLARGING, EXTENDING AND IMPROVING OF WATER PURIFICATION PLANT

MILAN, MISSOURI

Sealed proposals will be received by the Board of Aldermen of the City of Milan, Missouri, at the office of the City Clerk, in Milan, Missouri, until 7:30 o'clock P.M. on the 15th day of Sept. 1947, for the construction of a booster pumping station and for remodelling, enlarging, extending and improving of the existing Water Purification Plant of said city, at which time and place such proposals will be publically opened, read aloud and considered by the Board of Aldermen of said City.

Each bid shall be made on a printed form attached to a bound copy of the specifications and contract form for the work, which contract documents may be obtained from the City Clerk of Milan, Missouri, or from the Consulting Engineer, Jack Donaldson, Maryville, Missouri. The plans and specifications may be examined either at the office of the City Clerk in Milan, Missouri, or of the Consulting Engineer at Maryville, Missouri. Contractors desiring plans and specifications for their own use in preparing bids may obtain one complete set from the consulting Engineer by making a deposit of Ten Dollars ($10.00), Five Dollars of which will be refunded to unsuccessful bidders upon the return of the plans in good condition within thirty days after the date of opening bids.

Each bid shall be accompanied by certified check or Cashier's check drawn on some known responsible bank, in an amount not less than five per cent (5%) of the total bid, made payable to the City of Milan, Missouri, which may be retained by the City of of Milan for a period of 30 days after the day for the opening of bids. Bid checks of the unsuccessful bidders will be returned when their bids are rejected; the bid check of the successful bidder will be returned when such bidder has executed an acceptable performance bond in an amount equal to ninety per cent (90%) of the contract.

The contract will be let to the lowest and best bidder, but the City of Milan, Missouri, reserves the right to reject any or all bids without explanation, and to waive informalities in any bid submitted.

O. H. GRAMLING
City Clerk of Milan, Missouri

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